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HOW TO COLLECT AND OBSERVE

INSECTS.

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BY

*Albion Spring*

**A. S. PACKARD, JR.**

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FROM THE REPORT OF THE MAINE SCIENTIFIC SURVEY FOR 1862.

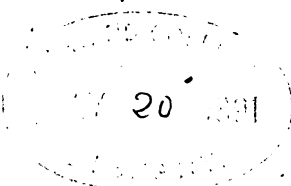
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Gift of  
John Harvey Trent,

# ENTOMOLOGICAL REPORT.

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BRUNSWICK, December 28, 1862.

*To the Gentlemen in charge of the Scientific Survey :*

I transmit herewith some instructions about collecting and observing the insects of our State, which will, I hope, lead to an extended cooperation in furthering the knowledge of the habits and forms of our noxious and beneficial insects.

Very respectfully,

Your obedient servant,

A. S. PACKARD, JR.

Dr. E. HOLMES,

Prof. C. H. HITCHCOCK.

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## HOW TO OBSERVE AND COLLECT INSECTS.

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### INSECTS IN GENERAL.

That branch of the Animal Kingdom, known as *Articulata*, is so called from having the body composed of rings, like short cylinders, which are placed successively one behind the other. In the class of *Worms* these rings or segments, are arranged in a continuous row, and their number is indefinite. The organs of locomotion consist of branches of cilia and bristles placed in a row, one on each side of the body; while on the first ring there are slender feelers directed forwards and placed around the mouth-opening. In the class of *Crustacea* this continuity of rings is broken; and there is a definite number, (21) which are gathered into two regions; the head-thorax and abdomen. The number of jointed legs is also indefinite, the number varying from ten to fourteen. In the class of *Insects*, the number of rings is still more limited, (14,) the head is distinctly separated from the thorax, thus forming, with the abdomen or hind-body, three distinct regions.

In the Insects again, there are three modes of disposing the rings, and their appendages :

1. Where the number of segments is indefinite, and much like each other in form, supporting both thoracic and abdominal legs ; as in the order of *Myriapoda*.

2. Where the head and thorax are closely united ; and there are eight pairs of legs attached to the thorax alone, as in the *Arachnida*.

3. Where there are three distinct regions to the body ; the head, thorax and abdomen, as in the *Insecta*. Moreover the true insects have three pairs of legs attached to the thorax ; and are winged.

The Myriapods grow by the addition of rings, after hatching from the egg ; the Arachnids by frequent moultings of the skin ; while the winged insects pass through a distinct metamorphosis. The young insect after being hatched from the egg is called the *larva*, from the Latin term meaning a *mask*, since it was the ancient belief that it concealed beneath its skin the form of the perfect insect. When full-fed, the pupa-skin rapidly forms beneath the tegument, and the insect in that form escapes through a slit in the back of the larva. The perfect insect is often called the *imago*. The larval state of insects which resembles worms, has also an analogous form to the Myriapods ; so spiders are analogous to Crustacea, while reminding us of the pupa state of the winged insects.

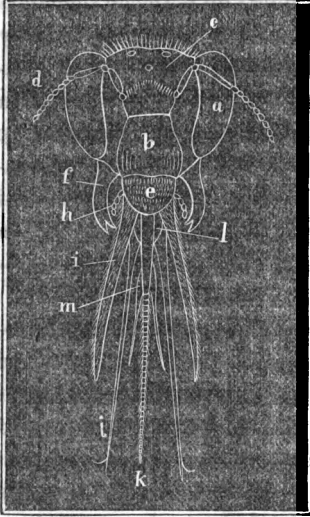
Moreover, worms and crustacea are, generally speaking, aquatic, breathing by gills, while insects are terrestrial and breathe by pores in the side of the body which communicates with a complex system of air tubes, including tubular blood vessels.

The order of winged-insects is subdivided into seven divisions, occupying an intermediate rank between orders and families, and called by naturalists *suborders*. Of these the *Hymenoptera* seem to be highest in the scale, and the *Neuroptera* the lowest.

Before characterizing these suborders, a few explanations will be necessary to understand the terms applied to the different parts. In insects as in the higher animals, the parts are repeated on either side of the middle of the body, with the exception of the single intestinal canal, and the dorsal vessel, which performs the functions of a heart.

In this head of a bee here figured we have all the parts connected with the function of sensation, and those adapted for seizing and

FIG. 4.



chewing the food. Two large *eyes* (*a*) composed of numerous facets, and three small simple *eyelets* (*c*) arranged in a triangle on the top of the head, and the *antennae* or feelers, (*d*) composed of numerous joints, are the most important sensory organs.—A pair of *mandibles* (*f*) for grasping, often toothed for tearing the food; two *maxillae* (*i*) for collecting and manipulating the food, on the base of which is a pair of *palpi*, (*h*) or touchers, which are used in conjunction with the antenna, as feelers; together with another pair articulated on to the *labium* (*l*) or so-called under lip, corresponding to the *labrum* or upper lip, which is attached to the *clypeus* (*b*);

and the labium which is prolonged into the *lingua* (*k*) or tongue having a pair of rudé palpi-like organs called the *paraglossæ* (*m*), form the organs for seizing and chewing the food.

Of the three rings of the thorax, the first (*prothorax*) is specialized to support the head; the second (*meso-thorax*) carries the first pair of wings (primaries;) the third (*meta-thorax*) carries the second pair (secondaries.) To each of these three rings is articulated a pair of five-jointed legs, of which the last joint or *tarsus* is divided into five smaller joints, the last terminating in two claws. The abdomen contains the viscera, and the organs of reproduction, surrounded, externally, by several pairs of sheath-like pieces in the male, which are in the female united into the ovipositor and its sheath-pieces. All these parts exist in a rudimentary state in the larva and pupa.

*Hymenoptera*, (Bees, wasps, &c.) are known by their hard compact bodies, distinct head and thorax, the small narrow wings irregularly veined, and by the possession of a hard ovipositor, often forming a poisonous sting. Their transformations are the most complete of all insects. The larva being most generally a white footless, helpless grub, partly curved, and rapidly tapering at each end. The pupa has the limbs free, contained in a thin silken cocoon. The species are all terrestrial.



*Lepidoptera*, (Butterflies and moths,) have the mandibles obsolete, the maxillae greatly prolonged and rolled up between the labial palpi; and soft bodies covered with scales; and broad, regularly veined wings, also covered with dust-like scales. Their transformations are complete. The active larvae assume a worm-like form with several pairs (1-5) of fleshy false legs besides the thoracic ones; they spin silken cocoons before changing to pupae (chrysalids, nymphs,) with the exception of the butterflies. The limbs of the chrysalids are soldered together, and the abdomen is movable upon the head and thorax. Some of the lower families are somewhat aquatic, feeding on water plants.

*Diptera*, (flies) have the mouth parts formed into a kind of proboscis; the second pair of wings are undeveloped, being reduced to a pair of pedicelled knobs serving as *balancers* or *poisers*. Their transformations are complete, the larva being maggots or elongated worm-like embryos. The pupae often change within the skin of the larvæ, which serves as a cocoon. The limbs are free. Many of the species are aquatic. Here we first find wingless parasites.

*Coleoptera*, or beetles, are known by their hard bodies, free and well developed mouth parts, and by the first pair of wings being hardened into sheaths (*elytra*) for the protection of the second pair. The larvæ called *grubs*, often have a terminal prop-leg besides the thoracic or true jointed legs, and pass by a complete metamorphosis to the imago state. The pupae are often protected by a cocoon, and have their limbs free. Some of the species are aquatic. One family is parasitic but is winged.

*Hemiptera* (bugs,) have the mouth parts formed into a sucking tube. The first pair are often thickened at the base and laid flat upon the abdomen, are thin, somewhat net veined, and inclined over the hind body. The transformations are incomplete, as in the orthoptera. The species are largely aquatic. Some lower groups are true wingless parasites.

*Orthoptera* (grasshoppers,) have free mouth parts, and the organs of nutrition very highly developed. The first pair of wings are still partly hardened to protect the broad net-veined hind pair which fold up like a fan upon the abdomen. The transformations are not complete, the larvæ and pupae resembling closely the imago, both being active. All the species are terrestrial.

*Neuroptera* have the mouth parts free again, the wings large and net-veined, the hind pair being often larger than the primaries.

Their bodies are more elongated than those of other insects. The metamorphosis is incomplete, the lavæ and pupæ closely resemble the imagines, and are both active, and with few exceptions they are all aquatic. The different species present strong analogies to all of the other suborders. The wingless lower genera present more analogies than other insects to the Myriapods.

Insects differ sexually in that the female generally has one abdominal ring less, and in being larger, fuller and duller colored than the males, while the males have often marked differences in the sculpture and ornamentation. In collecting, whenever the two sexes are found united they should be pinned upon the same pin, the male being placed highest. When we take one sex alone, we may feel sure that the other is somewhere in the vicinity; perhaps while one is flying about so as to be easily captured, the other is hidden under some leaf, or resting on the trunk of some tree near by, when every bush must be vigorously beaten by the net. Many species rare in most places have a *metropolis* when they occur in great abundance. There are also *insect years* like apple years, when a species is more abundant than for three or four years succeeding. The collector should then lay up a store, against years of scarcity.

In different seasons of the year insects are found in different stages; thus there are spring and fall insects, and summer species alone. Few insects hybernate in the perfect state, the species is more often represented in winter by the egg, or larva, or pupa. At no time of the year need the entomologist rest from his labors. In the winter, under the bark of trees and in moss he can find many species, or on trees, &c. detect their eggs, which he can mark for spring observation when they hatch out.

He need not relax his endeavors day or night. Nothing is night employment. Skunks and toads entomologize at night. Early in the morning, at sunrise, when the dew is still on the leaves, insects are sluggish and easily taken with the hand; so at dusk when many species are found flying; and in the night, when many species fly that hide themselves by day, and many caterpillars leave their retreats to come out and feed, and the lantern can be used with success to draw them out, the collector will be rewarded with many rarities.

There are species frequenting gardens, lawns, fields and deep woods, and swamps and pools, that are not met with away from

those localities. So there are insects frequenting mountains that are not found in the vallies below. More lepidoptera inhabit the summits of high mountains than beetles and other insects. In Maine there are found species which inhabit the sea coast alone, others that abound most on the sandy plains that run back from the sea to meet the hills of the interior, and some of the most productive places are those towns situated on the border of the low lands and hilly regions of the State. Other species are found only in the thick forests of the wild lands.

Moreover it has been found that two assemblages of insects called *faunae*, people the surface of the State. The one called the *Canadian fauna* comprises a large mass of species that inhabit British North America, the Great Lakes, and the lakes and forests of northern Maine, including Eastport and the coast towards Mt. Desert. The other assemblage called the *Alleghanian fauna*, is that which covers the southern half of the State, besides New-England generally, (except the White Mountain region which belongs to the Canadian fauna,) and sweeps down the Alleghany range towards the southern States. The plants of the summit of Mount Katahdin belong to a more arctic region still than the Canadian flora; whether the insects partake of the subarctic character remains to be determined.

#### HYMENOPTERA.

In studying this suborder we must remember that *every part of the body* varies in form in the different genera, forming admirable and plain distinctions to characterize the genera. To the form of the head and its appendages, that of the thorax and its appendages, the wings in the venation of which we can perceive at a glance those characters which separate genera, and in the legs especially of the fossorial families, where there are found to be great differences, the student must look closely. The best specific characters lie in the sculpturing and color, but the spots and markings are apt to vary greatly. The great differences in the sexes are liable to mislead the student, and hence large collections are indispensable to their proper study. The Hymenoptera are the most numerous in species of all the suborders except the Coleoptera. They have been less studied in this country than almost any other suborder, though so deserving from their interesting habits. Especial attention should be paid to collecting the smaller species, and to the families of the *Chalcididae*, the *Cynipidae* and the *Crabronidae*.

They should be pinned through the hard thorax, high up on the pin, and numbers should be preserved in alcohol.

Their habits should be studied long and patiently, and attention be given to rear in the same way as given for Lepidoptera, the saw-flies, the gall-flies, &c. The Eurytomae can be found in wheat fields, &c., after harvest; the galls in autumn.

*Apidae*, (honey bees, bumble bees, &c.) They are known from other families by their bodies being densely hirsute, the mouth parts lengthened and partially united to form a kind of proboscis that can be folded up out of sight under the head; and in their broad, flattened hirsute hind legs, adapted for collecting and carrying pollen. They are social, and the species often consists of *males*, or drones; *females*, or *queens*; and *imperfect females*, or workers, improperly called neuters, which are much smaller than the others. *Apis mellifica* is the honey bee, whose complex œconomy and hives are well known. Siebold, a German physiologist, has ascertained that the queen and neuters are hatched from fertilized eggs, while the drones come from eggs that are unfertilized. There is one queen to a colony or swarm. The workers sometimes lay eggs producing males, and there is a difference between them in other respects. The humble bees (*Bombus*) contain many species, which build hemispherical nests of moss under ground in pastures. The cells are large, oval and partially separate. There are from fifty to seventy in a swarm. The nests are built by the females, of which there are several in the spring which survive the winter; they then lay their eggs, which hatch out the workers late in the summer; soon after another brood of males and females alone, and in the fall, still later, a few more of both sexes appear. There are two kinds of females; the earlier born differing in size and producing male eggs only; so also there are two kinds of workers. The remaining species are solitary, and consist of males and females only.

*Xylocopa*, the Carpenter-bee, has black wings; it forms a tube a foot long, in which it lays its eggs, arranged in successive layers in masses of pollen.

*Megachile*, the Leaf-cutter, cuts circular pieces out of leaves, with which it makes a honey-tight cartridge-like cell, which it builds in holes excavated in trees and rotten wood.

*Osmia*, the Mason-bee, is blueish, and has a circular abdomen. It constructs its nest of sand, large enough to hold three to eight cells, in crevices in fences. Other species burrow in the sunny

side of cliffs or sand banks, or in rotten trees ; while others occupy dead snail shells.

*Coelioxys*, with a sharp triangular abdomen, is parasitic, laying its eggs in the nests of *Megachile*, *Osmia* and other bees.

*Nomada* is not hirsute, and in its slender form and gay colors resembles wasps. It enters the nests of *Andrena* and feeds on its food, hence it is called the Cuckoo-bee.

*Andrena* resembles very much the hive bee, though it is smaller. The *Andrenae* "are all burrowers in the ground, some species preferring banks of light earth, others hard trodden pathways, &c. ; their burrows differ in depth, but are seldom less than about six, whilst others excavate to nine or ten inches ; at the bottom of each burrow is formed a small oval cell or chamber, in which the industrious female lays up a small pellet of pollen mixed with honey ; these little balls are usually about the size of a garden-pea, varying somewhat in size in different species." *Smith*.

*Halictus* is one of the smallest of the family. *Angochlora* embraces bees whose bodies are slightly hirsute, and of a rich shiny green.

Mr. Fred. Smith, an English entomologist, says of the economy of this genus, that "it is so remarkably different from that of all other solitary bees, except of those belonging to the genus *Sphecodes*, that I am surprised it had escaped the researches of my predecessors, who, like myself, 'have loved to hear the wild bees' hum.' It will be observed that the females of *Halictus* and *Sphecodes* make their appearance in June, and are to be found from that time until late in autumn ; but no males of these genera will be observed until long after the appearance of the females : my observations on a colony of *H. morio* will serve as the history of the whole genus, making allowance for the different periods of their appearance. 'Early in April the females appeared, and continued in numbers up to the end of June ; not a single male was to be found at any time ; during the month of July scarcely an individual was to be found ; a solitary female now and then might be seen, but the spring bees had almost disappeared ; about the middle of August the males began to come forth, and by the end of the month abounded ; the females succeeded the males in their appearance about ten or twelve days : these industrious creatures began the tasks assigned to them, burrowing and forming their nests ; one of their little tunnels had usually others running into it, so that a single common entrance

served as a passage to several cells, in each of which a little ball of pollen was formed, and a single egg deposited thereon; the larvae were usually ten or twelve days consuming it, by which time they were fully fed; in this state they lay until they changed to the pupa-state, when they very shortly became matured.' I have reared individuals of *H. rubicundus* from the egg to the perfect insect; on the 15th of July I procured cells containing the pollen balls, with an egg on each; in twelve days the larvae were full-fed; the change to the pupa-state took place about the 25th of August, and during the first week of September the perfect state was acquired. The history of *Halictus*, therefore, is as follows: the males and females appear in the autumn; the latter being impregnated, pass the winter in the perfect state, appearing during the following season to perform their economy, as detailed above in the case of *H. morio*."

All these females of solitary species are found in spring on the blossoms of fruit trees, of wild cherries and about flowers.

*Vespidæ*, (wasps, yellow-jackets.) The hornet is the *Vespa crabro* of Europe. The group is characterized by the folding of the wings, longitudinally. *Vespa* lives in colonies of three kinds of individuals, constructing complex nests either under ground or attached to the branches of trees, consisting of several galleries of hexagonal cells, with their mouths downward, connected and supported by pedicels, and surrounded by an outer papery envelop. The females which have survived the winter begin in the spring to form their small nests, consisting of a single tier of a few cells, in which they lay their eggs and feed the young workers. The males and females do not appear until autumn. Reaumur has observed that there are two sizes among the males.

"Notwithstanding the powerful sting of the wasp, it is liable to the attacks of other insects. *Rhipiphorus paradoxus* and the larva of a *Volucella* infests its nests, devouring the larva; as does also *Anomalon vesparum*, and another species of Ichneumon. Dr. Leach also mentions that wasps are much infested by *Lebia linearis*. I have also observed a spider sucking a wasp, which it had killed."

—Westwood.

Wasps should, if possible, be collected by the whole colony, when the individual variation of the three kinds of individuals—the males, females and workers—can be studied. For this purpose visit the nests by night, plug up the hole with a sponge saturated

with ether or chloroform, and the inhabitants can thus be stifled. Or stand by the nest and net the insects as they go to or from the hole. Little or nothing is known about these interesting insects in this country, and persons who will spend the time can find out much that is new to their history. The following genera have no workers :

The common brown *Polistes* builds an exposed nest, consisting of few or many cells arranged in one tier, and attached to leaves and twigs by a short pedicel.

The solitary wasps, *Odynerus* and *Eumenes*, build nests of sand glued together and hidden in cavities, hollow branches, &c., and they store them with great numbers of caterpillars, flies, larvae of beetles, and spiders. Thus it seems that the larvae of the social wasps are daily fed with sweets by the workers, while those of the solitary species, which have no workers, have a store of insect-food laid up for them by the female.

The following families are truly fossorial sand-diggers, making their holes in sunny paths, &c., of which the ants are the most familiar examples. Their ovipositor is adapted for stinging, and by the poison conveyed into the wound, for benumbing their victims, which live for a long time half alive, for the larvae to feed upon.

"Although there is much general similarity in the habits of the truly fossorial species, there is considerable diversity in the details of their proceedings: thus, whilst *Oxybelus* conveys its prey by means of its hind legs, *Pompilus* and *Ammophila* walk backwards, dragging it with their mandibles. '*Astata*, *Tachytes*, *Psen*, *Crabro*, *Mellinus* and *Cerceris* fly bodily and directly forward with it in their mandibles, assisted by their fore legs.' *Shuckard*. From my own observations each species appears ordinarily to confine itself to its own particular prey. Instances are on record, however, in which considerable diversity in the prey of the same species has been observed; this probably arose from the female not being able to discover her legitimate prey; thus *Serville* and *Saint Fargeau* state that *Bembex rostrata* indifferently collects the species of *Eristalis*, *Stratiomys*, and the larger *Muscidae*; but it may be regarded as the ordinary rule that each species confines itself to its peculiar prey: thus, numbers of the same species of fly or larva are found in the same cell, although this must sometimes be a matter of difficulty." \* \* \* "The prey is moreover very various, comprising insects of nearly every order; the *Coleoptera*, Hem-

iptera, Lepidoptera, Hymenoptera, Diptera and spiders, contributing to the support of this tribe; and insects in the larva, pupa and imago state are employed for this purpose. The number of individuals enclosed in each cell varies according to the size of the species, and of the progeny for whose support it is buried: thus, whilst *Ammophila sabulosa* buries a single lepidopterous larva, as many as fifty or sixty Aphides are shut up in a single cell by other species." *Westwood*.

*Crabronidae*, sand-wasps. It is this family that many of the *Syrphus*-flies resemble so closely. They have cuboidal heads, a somewhat flattened, spherical thorax, and a flattened abdomen, rarely pedicelled. The fore legs are broad, adapted for digging, and they often have a broad, banner-like expansion, to use perhaps as a shovel, while the hind and middle legs are spined for retaining the prey the sand-wasp carries off. The insects are of moderate size; they are found resting on leaves in the sunshine. They occur generally rarely, and little is known of the extent or habits of the family in this country. *Crabro* (Fig. 5) has slender legs, and digs

FIG. 5.



into rotten posts, fences, stumps, where it makes its nest, provisioning it with caterpillars, flies, &c.. *Gorytes* has been seen protruding her sting into the frothy secretion of *Tettigoniae* on grass, and carrying off the insect. *Oxybelus* is a small, stout black genus, "its prey consists of Diptera, which it has a peculiar mode of carrying by the hind legs the while it either opens the aperture of its burrow or else forms a new one with its anterior pair. Its flight is low, and in skips; it is very active."

*Trypoxylon* has a long, club-shaped abdomen, and is black throughout. "Mr. Johnson has detected it frequenting the holes of a post pre-occupied by a species of *Odynerus*, and into which it conveyed a small round ball, or pellet, containing about fifty individuals of a species of *Aphis*; this the *Odynerus*, upon her return, invariably turned out, flying out with it, held by her legs, to the distance of about a foot from the aperture of her cell, where she hovered a moment, and then let it fall; and this was constantly the case till the *Trypoxylon* had sufficient time to mortar up the orifice of the hole, and the *Odynerus* was then entirely excluded; for although she would return to the spot repeatedly, she never endeavored to force the entrance, but flew off to seek another hole elsewhere."



*Shuckard.* *Cerceris* has a long abdomen, with convex rings. It is gaily marked with golden yellow. It has not been known to use its sting upon its captors. It lays up stores of young grasshoppers and *Curculionidae*. "*Philanthus* burrows in hot sandy situations, and provisions its nests with hive-bees; a single individual of which, after being stung, is deposited with an egg; and as each deposits five or six eggs, the number of bees destroyed must be at least equal to that, if not more considerable, which is most probable; and Latreille counted as many as fifty or sixty females occupied in making their burrows in a space of ground one hundred and twenty feet long." *Westwood*.

This is a most difficult family to study. The two sexes differ greatly, and are apt to be mistaken for distinct species, and the collector is fortunate if he comes upon a "metropolis" of a species. In limiting the species, more value must be placed upon the size and sculpture than the coloration, which varies greatly.

*Larridae*. This is rather a small group, having a sessile conical flattened abdomen, and with the legs of the females very hirsute. They are generally dark in color. They are caught about sandbanks. *Larra* provisions its nests with the caterpillars of small moths.

*Bembecidae*. We have but two genera, *Bembex* and *Monedula*, which have large heads and flattened bodies, bearing a strong resemblance to syrphus flies from their similar coloration. The labrum is very large and long, triangular, like a beak. The species are very active, flying rapidly about flowers with a loud hum. "The female *Bembex* burrows in sand to a considerable depth, burying various species of Diptera (*Syrphidae*, *Muscidae*, &c.,) and depositing her eggs at the same time in company with them, upon which the larvae, when hatched, subsist. When a sufficient store has been collected, the parent closes the mouth of the cell with earth." "An anonymous correspondent in the *Ent. Mag.* states that *B. rostrata* constructs its nests in the soft light sea-sands in the Ionian Islands, and appears to catch its prey (consisting of such flies as frequent the sand; amongst others, a bottle-green fly,) whilst on the wing. He describes the mode in which the female, with astonishing swiftness, scratches its hole with its fore legs like a dog. *Bembex starsata*, according to Latreille, provisions its nests with *Bombylii*." *Westwood*.

*Sphegidae*. The mud-wasps are known by their long antennæ, long hind legs and pedicelled abdomen. They are of large size, and

are colored black and red, brown and red, or wholly blue or black. They are very active, restless in their movements, and have a powerful sting. *Ammophila* is long, slender, with a long, pedicelled abdomen, the tip of which is red, and flies and runs on sunny paths and about pumps. "The species inhabit sandy districts, in which *A. sabulosa* forms its burrow, using its jaws in burrowing; and when they are loaded, it ascends backwards to the mouth, turns quickly round, flies to about a foot's distance, gives a sudden turn, throwing the sand in a complete shower to about six inches distance, and again alights at the mouth of its burrow."

"Latreille states that this species provisions its cells with caterpillars, but Mr. Shuckard states that he has observed the female dragging a very large inflated spider up the nearly perpendicular side of a sand-bank, at least twenty feet high, and that whilst burrowing it makes a loud whirring buzz; and in the Trans. Ent. Soc. he states that he had detected both *A. sabulosa* and *hirsuta* dragging along large spiders. Mr. Curtis observed it bury the caterpillars of a *Noctua* and *Geometra*. St. Fargeau, however, states that *A. sabulosa* collects caterpillars of large size, especially those of *Noctuae*, with a surprising perseverance, whereas *A. arenaria*, forming a distinct section in the genus, collects spiders." *Westwood*. *Pelopaeus*, which is the true mud-wasp, builds in length a row of parallel adjoining cells an inch or more long, and enveloped in an outer case of mud or clay, in the corners of rooms, on rafters, &c., enclosing in each cell some insect. *Pelopaeus coeruleus* is our common shiny blue "sand-dauber." *Pompilus* has a short pedicel to its abdomen, and very long hind legs. They run very swiftly in grass and over sandy places, looking like winged black spiders, on which they prey.

*Scoliidae*. This group has long, rather narrow hirsute bodies, with short, spiny fossorial legs, sessile abdomen, with two prominent terminal spines in the males, and often lunate eyes. They are black, often with bright yellow spots along the sides of the hind body. The genus *Scolia* is very large, often two inches long, marked with yellow. It is found in the hottest places about strongly scented flowers. It makes deep burrows in sand-banks, provisioning its cells with grasshoppers, &c. Other species are sluggish, crowding on stems of grass. *Sapyga*, known by its unusually narrow body and long, club-shaped antennæ, is said to be parasitic on bees of the genus *Osmia*, in whose nests it lays its eggs.

*Mutillidae*. This interesting family is characterized by the females

being wingless, by the want of the three ocelli on the top of the head that other hymenoptera possess, while the form of the body resembles the Scoliidæ, though more hirsute. They are deep red and black, and are solitary in their habits. They belong more to the Southern and Middle States,—one species only being found in Massachusetts. The females run in hot places, and hide themselves quickly when disturbed, while the males frequent flowers. They take flies by surprising them. The sting of *Mutilla coccinea* in this country is said to be very powerful. This family, in its wingless females and structural features generally, leads to the ants, where we have three kinds of individuals, as has been noticed in the bees, but differing in the workers being wingless.

*Formicidæ.* Ants have a triangular head, round eyes, long elbowed antennæ and slender legs. Some species have a sting like the other fossorial families. The males are much smaller than the females, and the wingless workers are a little smaller than the males. The mandibles in those species that do not themselves labor, but enslave the workers of other species, are slender and smooth, though they are generally stout and toothed. As in the bees, there have been found in some species two sets of workers, (a few being of larger size than usual, with very large heads,) which are said to make honey in cells, like worker-bees.

The habits of our ants in America have not been recorded. The little yellow ant that digs its holes in paths; the pismires that excavate their galleries in stumps; the ferocious red and brown species that raises its hills of sand in woods, or of clay in clayey places, and the large Pennsylvania ant nearly an inch long, whose colonies we find under boards, &c., are but little known. In collecting them they should be caught when swarming, that is when the winged sexes come out of their holes and fill the air in countless hosts. The little yellow ants swarm thus in the second week of September on a hot day that we generally have at that time. Hundreds of them should be pinned, or better, thrown into alcohol, keeping the colonies separate. So also their eggs, with the larvæ and pupæ, should be taken in large numbers.

Unlike the bees, ants are represented in winter by the workers alone, the winged sexes only appearing in the summer. After swarming, the females lay their minute eggs, and Gould, an English observer, says that those destined to hatch the future females, males, and workers, are deposited at three different periods. The larvæ are like those of hymenoptera in general, being footless grubs,

short, thick and white. How the larvæ are fed and the pupæ are cared for by the neuters, and the habits of ants generally, are found in all the books. Sometimes the pupæ are naked, but generally they are enclosed in thin cocoons.

*Chrysidæ*. These insects are very different from the ants in their oblong compact form, their nearly sessile oblong abdomen, having only three to five rings visible, the remaining ones being drawn within, forming a long, large jointed sting-like ovipositor which can be thrust out like a telescope. The abdomen beneath is concave, and the insect can roll itself into a ball on being disturbed. They are green or black. The sting has no poison-bag, and in this respect, besides more fundamental characters, the Chrysis approaches the Ichneumon family. They best merit the name of "Cuckoo-flies," as they fly and run briskly in hot sun-shine, on posts and trees, &c., darting their ovipositor into holes in search of other hymenoptera, &c. in which to lay their eggs. Their larvæ are the first to hatch and devour the food stored up by other fossorial bees and wasps. "St. Fargeau, however, who has more carefully examined the economy of these insects, states that the eggs of the Chrysis does not hatch until the legitimate inhabitant has attained the greater part of its growth as a larva, when the larva of the Chrysis fastens on its back, sucks it, and in a very short time attains its full size, destroying its victim. It does not form a cocoon, but remains a long time in the pupa state."

"In the Ent. Mag. has been noticed the discovery of *Hedychrum bidentulum*, which appears to be parasitic upon *Psen caliginosus*; the latter insect had formed its cells in the straws of a thatched arbor, as many as ten or twelve cells being placed in some of the straws. Some of the straws, perhaps about one in ten, contained one or rarely two, of the *Hedychrum*, placed indiscriminately amongst the others. Walkenaer, in his Memoirs upon *Halictus*, informs us that *Hedychrum lucidulum* waits at the mouth of the burrows of these bees, in order to deposit its eggs therein; and that when its design is perceived by the bees, they congregate together and drive it away. "St. Fargeau states that the females of *Hedychrum* sometimes deposit their eggs in galls, while *H. regium* oviposits in the nest of *Megachile muraria*; and he mentions an instance in which the bee, returning to its nearly finished cell, laden with pollen paste, found the *Hedychrum* in its nest, which it attacked with its jaws; the parasite immediately, however, rolled itself into a ball, so that the *Megachile* was unable to hurt it; it

however bit off its four wings which were exposed, rolled it to the ground and then deposited its load in the cell and flew away, whereupon the *Hedychrum*, now being wingless, had the persevering instinct to crawl up the wall to the nest, and there quietly deposit its egg which it placed between the pollen paste and the wall of the cell which prevented the *Megachile* from seeing it."—*Westwood*.

*Proctotrupidæ*, *Egg-parasites*. In this family are placed very minute species of parasitic Ichneumon-like hymenoptera which have rather long and slender bodies, with antennæ of various lengths, often haired on the joints, while the wings are covered with minute hairs and most of the nervures are absent. Here the ovipositor has its true function, and its puncture conveys no pain; this may be said of the remaining families of the hymenoptera. These minute insects which can scarcely be distinguished by the naked eye unless specially trained, are black or brown, and very active in their habits. They may be swept off grass and herbage, from aquatic plants, or from hot sand banks. They prey on the wheat-flies by inserting their eggs in their larvæ, in gall-midges, and gall-cynips, and in fungus-eating flies, in which places they should be sought. In Europe species of *Teleas* lay their eggs in those of other insects, especially butterflies and moths and hemipters where they feed on the juices of the growing larvæ and pupæ within the egg, coming out as perfect Ichneumons.

"*Myrmecovulorum* oviposits in the eggs of other insects from which the tiny parasite emerges only in the perfect state, a single butterfly's egg often nourishing the transformation of many individuals." A species of *Platygaster*, a short broad genus, lays its eggs in those of the Canker-worm moth just after their deposition. It is one twenty-fifth of an inch long. Another species infests the eggs of the Hessian fly. *Ceraphron destructor*, which is a larva-parasite of the Hessian fly, is a tenth of an inch long.

We must have many species of these insects in this country. They occur in great numbers where they are found at all. They are almost too small to pin, and if transfixed would be unfit for study, and should therefore be put into homeopathic vials of alcohol.

*Chalcididæ*. This is also a group of great extent, and like the preceeding, the species are of small size; but they are of shiny colors, as the name implies, being often bronzen, or metallic. They have also elbowed antennæ, and the wings are often deficient in nervures. In some genera, including *Chalcis* the hind thighs are

thickened for leaping. The differences between the sexes, generally very marked in hymenoptera, are here especially so. The male of *Eurytoma* has the joints of the antennæ swelled and furnished with long hairs above. Some of the species, such as those of *Pteromalus*, are wingless, and closely resemble ants.

They infest eggs and larvæ. Some species prey upon the Aphides, others lay their eggs in the nests of wasps and bees. One species is known in Europe to consume the intestines of the common House Fly. Others consume the larvæ of the Hessian fly, and those *Cecidomyiæ* that produce galls, and also the true gall flies (*Cynips*.) Some are parasites on other Ichneumon parasites, as there are species preying on the genus *Aphidius*, which is a parasite on the Aphis. So also in Illinois a species of *Hockeria* and of *Glyphe* are parasitic on a *Microgaster*, which preys upon the Army worm; and *Chalcis albifrons*, Walsh, was bred from the cocoons of *Pezomachus*, an Ichneumon parasite of the same caterpillar.

The genus *Leucospis* is of large size and known by having the ovipositor laid upon the upper surface of the abdomen, and by its resemblance to wasps. *Eurytoma hordeti* (fig. 6,) is found in gall-like swellings of wheat stalks. The pupæ of this family have often the limbs and wings soldered together as in *lepidopterâ*, and the larvæ seldom spin a silken compact cocoon as in the succeeding family. We have probably in this country a thousand species of these small parasites, nearly twelve hundred having been named and described in England alone. They are generally large enough to be pinned or stuck upon cards; some individuals should be preserved in this way, others, as wet specimens.

*Ichneumonidæ*. The Ichneumon-fly (Fig. 7,) represents the most extensive family of the suborder as regards numbers. They are long and narrow bodied, with long and straight antennæ; the ovipositor is generally long and protected by two sheath-pieces of the same length. In those genera that have the ovipositor short, the eggs are placed in exposed larvæ, while those provided with longer ones, such as in the figure, are adapted for penetrating into

FIG. 6.

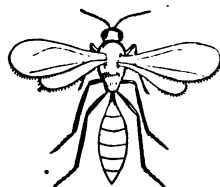
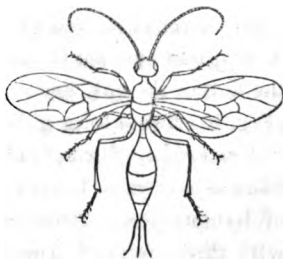


FIG. 7.



holes under bark, or in crevices, &c., and for this purpose they are often two or three times the length of the body. There are scarcely any insects which do not suffer from the attacks of these parasites. They are the best friends of agriculturists. The eggs are either laid on the surface of the larvæ, when they eat their way inwards; or the egg being placed within the body of the victim, it hatches out and feeds on the fatty issues of the larvæ, gradually consuming its life until the parasite turns to pupa, when it dies. There may be one large *Ichneumon* thus feeding within, or numbers of them. Thus the caterpillar of *Acronycta*, found on the alder in October, is often seen adhering to the leaf, preserving the semblance of life, while the inside of the body is packed with little cocoons placed vertically next to one another.

Of course *Ichneumons* abound most in summer when larvæ are most plenty, when they are found in great numbers on umbelliferous flowers. But many species appear in April. The species of *Ophion*, with compressed arched yellow bodies, come to light in summer. In Europe nearly 2000 species of this family have been described. *Evania*, with its very short abdomen, *Pelecinus*, with a very long one, which is abundant in summer, represent a small family, the *Evaniidæ*, which lead to the

*Cynipidæ*, or Gall-flies. The species are of small size, with short broad heads, a globular thorax, and short compressed abdomen. With their long slender ovipositor they insert their eggs into leaves, &c. which causes by the irritation a hollow swelling on the leaves, buds or stalks of plants. Those large swellings on oaks imported from the East, known as *galls*, have given the name to these productions. Galls are of various forms and sizes, and differ with the species of gall-fly that produces them. They may contain one or several grubs, which are small, fleshy and footless, with tubercles in the lower surface instead of feet, to move by. The eggs increase in size as the gall itself enlarges. A wingless species in England makes its galls at the foot of the oak, beach, &c. *Cynip dichlocerus*, (Fig. 8.) forms long galls in the stem of rose bushes.

FIG. 8.



*Uroceridæ*, Boring-sawflies. These rather rare insects pass their lives as borers in the trunks of trees. Unlike the previous families of hymenoptera, their larvæ are long, cylindrical, and furnished with three pairs of true legs. The saw-flies are likewise cylindrical and long, and the sides of the body continuous, not being

insected as usual, while the abdomen is blunt, and a large saw-like ovipositor projects from beneath. They are among the largest of hymenoptera. *Tremex columba* bores into beech trees. *Urocerus albicornis* and another species is found on pines. *Oryssus* is a much smaller genus with a slender ovipositor. There are but few species, and they are found in August flying about with a loud buzz.

*Tenthredinidæ*, Saw-flies. We now come to a family whose affinities are closest to the Lepidoptera. In their bodies the three divisions are less marked than usual, they only fly in the warmest days, their larvæ have 18-22 legs, and closely resemble caterpillars, and like them feed exposed on leaves. The flies are sluggish; their heads are transversely oblong, and the antennæ are simple, club-shaped or feathered. Their wings are folded at rest upon the body, overlapping each other somewhat. Their ovipositors are toothed like little saws, with which they bore into the stems and leaves of plants to deposit their eggs. The larvæ spin compact cylindrical oval cocoons. They are found in companies on the leaves of the alder and birch, holding on by their true legs while the rest of the body is suspended and curved curiously upwards; or they occur as slimy slugs on the leaves of the pear and rose, while others feed on the stems of plants, or construct cases of bits of leaves to hide in, like Tineids, or roll up a leaf like the Phyganeidæ. The large solitary larva of *Cimbex Americana* is found partially rolled up, on the elm and birch. *Lophyrus abietis* (Fig. 9, female,) feeds on the fir. *Selandria vitis* and *rosæ* feed upon the vine and rose, and can be taken when those plants have leaved out. Many can be taken early in summer about alders and willows.

FIG. 9.



#### LEPIDOPTERA.

*Butterflies* are easily distinguished from the other groups by their knobbed antennæ; in the *Sphinxes* and their allies the feelers are thickened in the middle; in the *Moths* they are filiform and often pectinated like feathers. Lepidoptera have also been divided into three large groups, called Diurnal, Crepuscular and Nocturnal, since butterflies fly in the sunshine alone, most Sphinxes in the twilight, (many of them fly in the hottest sunshine,) and the moths are generally night-fliers, though many of them fly in the day time, thus showing that the distinctions are somewhat artificial.

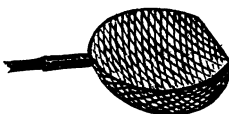


In studying these insects the best generic characters will be found in the antennæ, the shape of the head parts, the neurulation and proportions of the wings. Very slight changes in these parts separate genera. Size and coloration, which are very constant, afford good specific characters.

The caterpillars, chrysalids and perfect insects, besides being preserved dry, should be collected largely in alcohol. In collecting them to pin dry we must remember that the least touch will remove some of the scales from the wings and bodies, thus injuring them for study and spoiling their looks. The collector should have the *ring net*, the *beating net*, plenty of pill boxes, a large box lined with cork to pin his captures into, which should have pinned in the bottom a sponge saturated with benzine, (which is the cheapest poison,) and though after frequent airing the box loses the strong odor, yet there is enough left to keep the specimens from fluttering, until more can be applied at home. This box should be small enough to slip into the coat pocket, and with the cover made to open easily with one hand. A bottle of alcohol is needed about the person for the reception of duplicates, larvæ, &c. Pins of various sizes should be carried in a cushion suspended from the neck or from a button-hole. The best insect pin is that of German make. The different sizes can be had of F. W. Christern, 763 Broadway, and Theodor Schreckel, 14 North William street, New York. Two sizes, No. 2 and 5, which come done up in square packages of five hundred pins each, will do for the majority of insects, the larger for butterflies and Sphinges, Noctuæ and Geometræ, while for the micro-lepidoptera smaller pins are needed, which will be mentioned further on when speaking of them more specially. The *net* most convenient is a sugar-loaf-shaped bag of silken gauze (which can be bought as cheaply as muslin or mosquito-netting, and does much better,) fastened to a margin of cloth sewed previously onto the ring. The net should be made a foot and a half deep, attached to a frame of stout brass wire twelve inches across, which should be soldered on to a tube half an inch or so in diameter, into which a slender stick six feet long can be thrust. A light net like this can be rapidly turned upon the insect with one hand. The *beating net* is stouter and made of thick muslin, and fastened on to a short stick. It is used for beating bushes and herbage for moths and their larvæ. It can be also used for collecting all other insects. In this connection should be mentioned the *water net*, (Fig. 10,) which may be round, or of

the figure indicated. The ring should be of brass, and the shallow net be made of grass-cloth or coarse millinet. Small aquatic species can be fished up in mud which will strain through the net, leaving them to be picked up and pinned. When the insect is taken in the bag-net by a dexterous twist of the handle, which throws the bottom over the mouth, it should be confined with the other hand with great care, and then pinned through the thorax, when in the net. The pin can be drawn through the meshes upon opening the net. The pin should be thrust through the thorax so that three-fourths of it should be below the insect; care should be taken to preserve some uniformity of height from the cork in the different specimens. After being pinned the specimen should be handled with a pair of curved pincers, whose jaws should be roughened to retain the pin, and kept apart by their opposite ends being united, as in the surgeon's dissecting forceps; or the handles may be large, and a special spring introduced between to keep the branches apart. These pincers are indispensable in handling specimens, especially those on slender pins.

FIG. 10.



Some specimens should be preserved as they look when at rest. To set specimens a number of *setting-boards* will be necessary. These should be made of soft wood, with grooves or cracks of different sizes, in the bottom of which strips of cork, or corn-stalk, or paste-board should be fastened, into which the insect's body can be received, while the pins stick through beneath. The surface of the board should incline a little towards the groove, as the wings often fall down a little after the specimen is dry. The wings can be arranged with a needle stuck into a handle of wood, the wings set horizontally, and the front margin of the primaries drawn a little forward of a line perpendicular to the body, so as to free the inner margin of the secondaries from the abdomen, that their form may be clearly seen, as in the figure (11.) When thus arranged they can be confined by pieces of card, as indicated, or by square pieces of glass laid upon them. Several days are requisite for them to dry thoroughly. Several of these setting-boards can be made to slide into a frame covered with gauze-wire, to keep them from devouring insects, while the air may at the same time have constant access to them.

FIG. 11.



*Rearing Caterpillars.* The larvæ of butterflies are rare; those of moths occur more frequently, while their imagines may be scarce. In some years many larvæ, usually rare, at other times occur in abundance, when they should be reared in numbers. In hunting for caterpillars bushes should be shaken and beaten over newspapers or sheets, herbage should be swept carefully, and trees examined carefully for leaf-rollers and miners. The best specimens of moths and butterflies are obtained by rearing them from the egg if possible, or from the larvæ or pupæ. In confinement the food should be kept fresh, and the box well ventilated. Tumblers covered with gauze, pasteboard boxes, pierced with holes and fitted with glass in the covers, or large glass jars, are very convenient to use as cages. The bottom of such vessels may be covered with moist sand, in which the food plant of the larva may be stuck and kept fresh for several days. Larger and more airy boxes, a foot square, with the sides of gauze, and fitted with a door, through which a bottle of water may be introduced, serve well. The object is to keep the food plant fresh, the air cool, the larva out of the sun, and in fact everything in such a state of equilibrium that the larva would not feel the change of circumstances when kept in confinement. Most caterpillars change to pupæ in the fall; then they should be covered with earth, kept damp by wet moss, and placed in the cellar until the following summer. The collector in seeking for larvæ should carry a good number of pill-boxes, and especially a close tin box, in which the leaves may be kept fresh for a long time. The different forms and markings of caterpillars should be noted especially, and they should be drawn carefully, on a leaf of the food plant, and the drawings and pupa skins, and perfect insect, be numbered in the same way. Descriptions of caterpillars cannot be too carefully made or too long. The relative size of the head, its ornamentation, the stripes and spots of the body, and the position and number of tubercles, and the hairs, or fascicles of hairs, or spines and spinules, which arise from them, should be noted, besides the general form of the body. The lines along the body are called *dorsal*, if in the middle of the back, *subdorsal* if upon one side, *lateral* and *ventral* when on the sides and under surface, or *stigmatal* if including the *stigmata* or breathing pores, which are generally parti-colored. Indeed, the whole biography of an insect should be ascertained by every observer; the points to be noted are:—

1. Date, when and how the egg is laid; and number, size and marking of the eggs.

2. Date of hatching, the appearance, food-plant of *larva*, and number of days between each moulting; the changes the larva undergoes, which are often remarkable, especially before the last moulting, with drawings illustrative of these; the habits of the larva, whether solitary or gregarious, whether a day or night feeder: the Ichneumon parasites, and their mode of attack. Specimens of larvæ in the different moultings should be preserved in alcohol. The appearance of the larvæ when full-fed, the date, number of days before pupating, the formation and description of the cocoon, the duration of larvæ in cocoon before pupation, their appearance just before changing, their appearance while changing, and alcoholic specimens of larvæ in the act, and drawings illustrative—all these should be studied and noted.

3. Date of pupation; description of the pupa or chrysalis; duration of the pupa state, habits, &c.; together with alcoholic specimens, or pinned dry ones. Pupæ should be looked for late in the summer or in the fall and spring, about the roots of trees, and kept moist in mould until the imago appears.

4. Date of the insect's escaping from the pupa, and method of escape; duration of life of the imago; and the number of broods in a season. Labels for alcohol may be written in pencil on paper, or in ink on parchment.

*Papilionidæ.* The Swallow tails are at once known as being our largest butterflies, and by their having the hind wings produced into a tail-like appendage. The yellow *Papilio Turnus* flies in June and July, through woods and about lilacs. Its larva feeds on the apple, and wild thorn. It is green, with two eye-like spots on the thorax. *P. asterias*, the Parsnip Papilio, flies in August about wild parsnip, which grows by river sides; and is found upon the cultivated species. It is dark blue. The larva is yellow, striped and spotted with black. When sailing free on their wings it is almost impossible to capture them. The larvæ when irritated, push out a V-shaped yellow organ from the head.

*Pieridæ.* (White or Sulphur Butterflies.) *Pieris oleracea*, is white with rounded secondaries or hind wings. It feeds on cabbages and turnips. Its larvæ are hirsute, green, tapering towards each end of the body, and feed on grass. Those of *Colias Philodice* are green and smooth. This is our common "Sulphur Yellow," abounding in roads.

*Nymphalidæ.* *Argynnis* is known by the under side of the wings

being covered with silvery spots, while the larvæ are spined, as are those of *Vanessa* and *Grapta*, whose species are the earliest to appear in spring. *V. antiope* is the large purple-species that flies from March to October; its gregarious larvæ feed on the willow and elm. *Grapta progne* with notched red and brown wings, is common in May and September, in woods and about houses; its solitary larvæ feed on the currant. *G. comma* inhabits the northern part of the State. All the species have silvery comma- or semicolon-like markings on the under surface of the secondaries.

*Satyrus* has the wings broad and rounded, with eye-like spots near the outer margins, and it is of a soft brown color. It is seen as it flies, rising and falling gracefully over fields and through woods. *S. eurythris* inhabits pine woods. It flies towards the last of June, and is the first species of the genus to appear. The others are August species. *S. alope* flies in fields about clumps of golden rod, *S. canthus* by rivers and in low places. *Neonympha semidea* is found only on the summit of Mt. Washington. It must be looked for upon Mt. Katahdin. The larvæ are smooth green, often striped, with forked tails, and feed on grass. They are rarely found and should be especially sought for. By their larval forms and skipping flight these wood Satyrs lead to the small sized—

*Lycaenidæ*. *Lycaena Americana* is our common little copper butterfly. Its larva is green, oval, flattened, and feeds on sorrel. The pupa is short and thick, and is fastened by a loop to the under surface of stones.

The Azure butterflies *Polyommatus pseudargiolus*, and *P. comyntas* and *P. lucia*, are pretty species which occur frequently in May, and sometimes in April, on sunny days. *Comyntas* is an August species and has not been found in Maine yet. *Thecla* contains coppery brown species with a slight tail to the secondaries, which fly early in forests. *T. mopsus* and *niphon* are our two common ones; they may be easily captured when alighted in paths. Our largest one is *T. falacer*, which has an orange colored spot on the inner angle of the secondaries, and two unequal tails. It is rare and found in August.

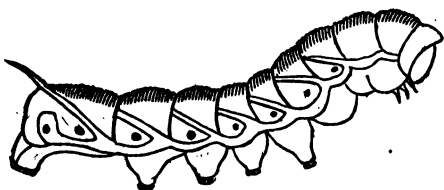
We come now to butterflies with stout bodies, and large heads, whose antennæ have the knob as if untwisted and bent to one side, approaching the form of the antennæ of the Sphinges. Moreover their flight is swift and strong, while they generally skip with a jerking flight. Their colors are a soft rich brown, with yellow square spots. Such are the—

*Hesperiadæ* or Skippers. The green caterpillars have large heads, and taper rapidly towards either end. They are solitary, feeding within rolled up leaves, as the Tortrices, or exposed on the surface. "Their chrysalis are generally conical, or tapering at one end, and rounded, or more rarely pointed, at the other, never angular or ornamented with golden spots, but most often covered with a bluish white powder or bloom. They are mostly fastened by the tail and a few transverse threads, within some folded leaves, which are connected together by a loose internal web of threads, forming a kind of imperfect cocoon." *Harris*.

*Eudamus bathyllus*, is a very common species. It is of a darker brown than usual, with a few small white spots. It is common in June and July in paths, and easy to capture.

*Sphingidæ*. (Hawk moths, Humming-bird moths.) These are the largest bodied of the lepidoptera. They have narrow thick wings which enable them to fly with great rapidity, as they frequent flowers at dark or before sunrise in the morning, inserting their long maxillæ into the flowers like humming-birds, which they are often mistaken for. They are found about Lilacs, pinks and honey suckles in June and July. *Sesia diffinis* and *Thysbe* are smaller clear winged moths with flattened bodies and have spreading tufts like the tails of humming-birds on the tip of their hind body; they fly in the hottest sunshine, about the flowers of the orchard, of the Rhodora, Kalmia, Lilac and Pink, &c. Our smallest and rarest species is the *Ellema Harrisii*, which lives on pine trees, and is taken in their vicinity at flowers. The large *Macrosila carolina* is not found in Maine. Our largest species is *S. cinerea*; next to that the *S. drupiferarum* which feeds on the plum; *S. gordius* is our most common species in Maine, and feeds on the apple. The larvae are large green caterpillars with a terminal horn, and have the queer habit of elevating the head and front part of the body, (as in Figure 12,) in a Sphinx-like attitude.

FIG. 12.



*Ceratonia quadricornis* has a larva with four short fleshy horns on its thorax. It feeds on the elm. By thrusting a pin dipped into oxalic acid into the body of the moths they can be quickly killed, as also by the fumes of benzine. The larva are found crawl-

ing about in September. They descend into the ground and make a rough earthen cocoon before pupating. The chrysalis has the tongue case detached.

*Smerinthus* has notched wings, and the secondaries are ocellated. The larvae have triangular heads. *S. geminatus* feeds on the apple. *Deilephila* feeds on the Willow herb.

*Egeriadae*. These are small species whose larvae are borers. The moths have delicate transparent wings and slender bodies, elegant and gaily colored. *Egeria cucurbitae* feeds upon the squash. *E. exitiosa* bores in peach trees. These two species have the sexes very distinct. The species bear a close resemblance to some hymenoptera. *Trochilium tipuliforme* is a slender blue species. It bores in the stems of the current, and by splitting the stems open in the fall and spring, we shall find the larvae. Towards the last of May they turn to pupae. In the middle of July they appear, often abundantly, flying with great rapidity about the leaves, like certain hymenoptera. They are easily caught with the net. The species are rarely met with.

*Zygaenidae*. The members of this family which contains but a few New England species, fly in the middle of warm sunny days. They are generally blue, with pectinated or nearly simple antennae, slender bodies, and rather narrow wings, and they are covered with fine powdery scales. *Procris americana* is a slender bodied species, of a deep blue color, and saffron-yellow collar, and spreading anal tuft, which feeds on the vine or common woodbine (*Ampelopsis*.) Its larva is short and thick, yellow, with tufts of short black hairs across the rings. Those caterpillars of genera which approach more to the Lithosians have the body more elongated, and thickly covered with whorls of thick set hairs. *Otenucha latreillana* has a yellow larva of this description, which is found early in summer feeding on grass. In June it makes a thin cocoon of hairs, and in the last of July appears in fields, flying in the hot sun. It is our largest species, of a dark blue color, and with well pectinated antennae. *Glaucopis Pholus* is a smaller species, with serrated antennae, and the base of the wings are yellow. It feeds as a larva on lichens, and flies about stone walls.

*Bombyces*. Spinners. This handsome family comprises species of the largest and most regal moths. Their thick heavy bodies and small sunken heads, and often obsolete mouth parts, pectinated antennae, broad wings, and sluggish habits, notwithstanding

the numerous exceptions, afford good characters for distinguishing them. Likewise the thick hairy larvae, which spin silken thick cocoons, and change to short thick pupae, separate this family. There are several well marked minor groups, of which the Lithosians, with their slender bodies and wings, simple antennae, and slender verticillated larvae, head the group. They are also day fliers. Most of the group have narrow wings, such as *Deiopeia bella* which has bands of white enclosing dark spots on the fore wings, and scarlet hind wings, edged without irregularly with black. The species of *Crocota* of uniform pale red, look like Geometrids, and *Nudaria* has broad, nearly transparent wings, with square thinner spots.

The *Arctians* have thick bodies, and simple or feathered antennae. Their larvae have whorls of long spinulose hairs, as in the "yellow bears," the young of *A. isabella*, the buff brown species, which is yellow and black, and curls up and lies on its side when disturbed. The common yellow caterpillar is the young of *Spilosoma virginica*, a white species found in gardens, in August. *S. acraea* has a partly buff body, its larva is the Salt Marsh Caterpillar. *Halesidota* has a short thick larva, with raised middle tufts. The moths are yellowish with cross bands of spots, often partially transparent. They lead to the *Dasychirae*, or tussock caterpillars, which have long pencils of hairs projecting before and behind the body. The pretty larva of *Orgyia* is variously tufted and colored, and feeds on garden vegetables. The moths fly in the sunshine in September, and resemble Geometrids. The thick and woolly bodied, pale yellow crinkled-haired genus *Lagoa*, leads to the *Cochlidiae*, a most interesting and anomalous group, when we consider the slug-like, footless larvae, which are either hemispherical, boat-shaped, or oblong with large fleshy spines. The moths are small, thick bodied, and with antennae pectinated two thirds of their length, or they are slender bodied with simple feelers, and resemble closely some of the Tortrices. They are very difficult to raise, as they generally die in confinement.

The *Notodontians* have larvae singularly humped, with naked or slightly hairy bodies, having the last pair of prop-legs often prolonged and not often used in locomotion, being when at rest elevated over the back. The moths resemble very closely *Noctuae*. They may be distinguished by their small, sunken heads, feathered antennae, and often by the tufted inner margin of the primaries.



The *Platypterycidae* have broad falcated wings, closely resembling the Geometrids, and the larvæ have the last pair of prop-legs united and greatly prolonged. The *Bombycidae* include the *Bombyx mori* or the silk-worm. The *Atticidae* are the central group of the family. The very large, eyed wings and broad doubly pectinated antennæ of this kingly assemblage of moths, and the large, thick, fleshy larvæ with angulated wings, surmounted by scattered tubercles, giving rise to a few short hairs, are represented by *Samia cecropia* and *promethea*, which have the discal spots triangular; *Tropaea Luna* is the immense, tailed, green species, while *Telea Polyphemus* is brown and has large transparent eye-like discal spots. The *Ceratocampadae*, include *Citheronia regalis* and *Eacles imperialis*, which are of gigantic size, and the smaller *Saturnia Maia* and *Hyperchiria Io*, which have triangular subfalcate primaries. The larvæ are cylindrical and armed with hair bearing tubercles; or, as in *Dryocampa*, they have smooth bodies, with a pair of slender horns just behind the head.

The two species of *Clisiocampa*, of which *Americana* and its larva are here figured, (13 and 14,) represent another small group. The leaf caterpillars are most injurious to orchards. The moths fly at light in July.

The *Hepialidae* have long, narrow wings, with both pairs much alike. Their larvæ live in the roots and stems of plants. The moths come to light in July and August, and are rare. *Xyleutes robinix* is stout bodied, and bores in the locust tree.

*Noctuidae*. (Owlet moths.) There is great uniformity in the genera of

this family, which are characterized by their thick bodies, stout and well developed palpi, simple and sometimes slightly pectinated antennæ. The wings are small and narrow; they fly swiftly at night, and are attracted by light. The primaries have almost invariably a dot and reniform spot on the middle of the wing, and they are generally dark and dull colored. The larvae taper towards each end, and are striped and barred in different ways. They make thin, earthen cocoons. The *Acronyctae* are light gray species, with haired larvae, and approach the Bombyces closely. The *Leucaniae* are whitish yellow, with naked larvae, such as the Army-

FIG. 13.



FIG. 14.



worm. The *Agrotæ* or Dart moths have broad tips to the palpi, their antennæ pectinated, and the spaces between the dot and reniform spots dark and conspicuous. The larvae are the noxious *cut*s worms. They lead to the *Mamestræ*, which usually have a W in the middle of the outer line of the primaries; they have rather broad wings, and are of large size. The larvae are long, cylindrical and naked. *Gortyna*, the spindle-worm and its allies, have somewhat falcated wings. The *Acontians* are small, slender bodied, often white species, which fly in the day time about flowers. *Xylina* and *Oucullia* are large dart moths, with tufted fronts. *Plusia* is marked with silver spots.

The previous groups of genera have stout, blunt palpi, and narrow wings; but the *Catocalæ* have broad wings, filiform antennæ, and long, slender palpi, which reach often beyond the top of the head. Moreover, the larvae are elongated, and have fourteen legs, and a semi-looping gait, approaching closely to Geometrids. *Catocala* is very large, with gray fore wings, and beautifully scarlet, vermilion, or black striped secondaries. *Erebus odora* is a gigantic species, dark as night and faintly banded. *Homoptera lunata* and allies are similar but much smaller broad winged Noctuæ.

*Noctuæ* can be taken at dusk flying about flowers, and they enter open windows in the evening and night in large numbers, attracted by the light within. When lighted on the table under the lamp a slight tap with a ruler will kill them without injuring the specimens. In warm, foggy evenings they come in in great numbers. July and August are the best months for this family, but many species occur only in autumn, while others hybernate and are taken early in the spring. "Moths are extremely susceptible of any keenness in the air; a north or east wind is very likely to keep them from venturing abroad. Different species have different hours of flight. Thus, on a mild and dark November evening *Pæcilocampa populi* will occupy from seven to ten o'clock, after which it will make way for *Petasia cassinea*, which will fly till one or two o'clock in the morning. I have, for experiment's sake, sat up in the summer till three o'clock, when the whole heavens were bright with the rising sun, and moths of various kinds have never ceased arriving in succession till that time. Some of these must come from a considerable distance: *Scotophila porphyrea*, being a heath-moth, must come nearly a mile." *Bird*.

"In April the willows come into bloom. In the day time they

are very attractive to bees, *Bombi*, *Andraenæ*, &c., and a few beetles also. At and after dusk the flowers are the resort of several species of moths, (*Noctuina*,) some of which have hybernated, and others have just left their pupa state. It is now some fifteen years since the collectors first took moths in this way, that were likely long to have remained deficient in the collections but for the discovery, by Mr. H. Doubleday, of the attractive powers of the sallow blossoms. I believe it was the same gentleman who found out about the same time that a mixture of sugar and beer, [or rum and sugar or molasses, &c.,] mixed to a consistence somewhat thinner than treacle, is a most attractive bait to all the *Noctuina*. The revolution wrought in our collections, and our knowledge of species since its use, is wonderful."

"The mixture is taken to the woods, put upon the trunks of trees in patches or stripes, just at dusk. Before it is dark some moths arrive, and a succession of comers continues all night through, until the first dawn of day warns the revellers to depart. The collector goes, soon after dark, with a bull's-eye lantern, a ring net, and a lot of large pill-boxes. He turns his light full on the wetted place, at the same time placing his net underneath it, in order to catch any moth that may fall.

"The sugar bait may be used from March to October with success, not only in woods, but in lanes, gardens, and whenever a tree or post can be found to put it upon. The best nights will be those that are warm, dark and wet; cold, moonlight, or bright, clear and dry nights are always found to be unproductive. It is also of no avail to use sugar in the vicinity of attractive flowers, such as those of willow, lime or ivy. Sometimes one of the *Geometrina* or *Tineina* comes, and occasionally a good beetle." The *Virgins' Bower*, when in blossom, is a favorite resort of *Noctuæ*. Many can be taken by carrying a kerosene lamp into the woods and watching for whatever is attracted by its light.

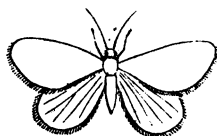
*Geometridæ*. (Geometers, Measuring-worms, Span-worms.)—This is a large group of slender-bodied, broad winged moths, with feathered antennae, which at rest have the wings nearly expanding, hardly overlapping each other. The larvae have but ten legs, walking with a looping gait. At rest they often hold themselves out straight and stiff by the muscles of the anal prolegs. *Ennomos* and allies have stout, rather wooly bodies, and angulated wings. They are generally yellow, dusted with ochreous, and the larvae

are large, tuberculated, and spin rather thick cocoons among leaves. *Boarmia* has wings crossed by numerous bands of dark irregular dots. The *Macariæ* have falcated primaries, and are of smaller size than the foregoing groups. The allies of *Abraxa* have wings rounded at the apex. A species that is pale buff with smoky spots, inhabits the currant, whose larva is golden yellow with white and dark spots. Some genera have wingless females; such as *Hybernia* which appears in October, and whose wingless female is ornamented with a double row of square black spots along the back; and the canker-worm (*Anisopteryx vernata* Fig. 15, larva, Fig. 16, moth,) which is rarely found now in Maine, but will probably be abundant before many years.

FIG. 15.



FIG. 16.



*Acidalia* is a very delicate slender bodied genus, of large extent, whose wings are banded much as in the *Boarmiæ*. The genus *Geometra* which is large and green, we do not have here; but some smaller species belonging to the genus *Racheospila*, whose abdomens are scarlet spotted above are frequent. The smallest species are found in the *Eupithiciæ*, which have long triangular wings. Nearly all the species can be taken in June and in July, in damp shady woods, or in open fields. *Larentia* and *Cidaria* come at light with Noctuids in July and August.

*Pyrakidæ*. (Delta moths.) The species have the habit of placing the wings in the form of a triangle, when at rest, since they do not overlap each other. Their bodies are slender, the antennæ nearly always simple, while the palpi are greatly enlarged, so as sometimes to be thrown back over the head. *Hypena* and its allies are of large size; the fore legs are frequently curiously tufted. They are found in company with Geometrids. *Hydrocampa*, as a larva feeds on aquatic plants, constructing a case like the Phryganeids, which it carries about with it. *Pyrausta* is generally red, striped with dark. *Botys* (Fig. 17,) is of a pale straw color with transparent spots, and long slender body and legs.

FIG. 17.



*Aglossa* is found about houses, and feeds on fatty substances. Some of the larvae are half-loopers, while those of the smaller species are naked, or with a few scattered hairs, slender and cylindrical. The smaller species are nearly all taken in damp places, in meadows,

grass lanes, or by rivers and pools in summer. Some of the species are day fliers.

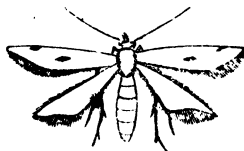
*Tortricidæ*. (Leaf-rollers.) These are small, broad-winged moths, which at rest fold their wings, roof-like, over their bodies, FIG. 18. in the form of a triangle, (as in Fig. 18.) They are abundant in June and July, in low bushes, herbage, or on leaves of trees, where they can be swept by the net. The larvae are rather thick greenish caterpillars, which roll up leaves; their work can thus be easily detected. When disturbed they wriggle out of the other end of their domicile, and let themselves down by a silken thread. Others feed on buds and flowers, such as *Loxotænia*; while another tortrix *Carpocapsa pomonella*, the "Codling moth," lays its eggs in the plumage of the young apple, and in the fall is found as a white fleshy grub in the core.



*Tineidæ*. These are the smallest of moths, and are known not only by their minute size, but by their narrow wings, often falcate, or pointed acutely in both pairs, and edged with a long fringe of exceeding delicacy. The maxillary palpi are greatly developed, while the labial palpi are of their usual size, and are sometimes recurved as in the Pyralidæ.

*Crambus* and its allies have long palpi and oblong wings, generally white and buff yellow, sometimes ornamented with golden spots. They fly in grass in great abundance, resting on the spears with their heads down. To this group belongs the *Bee moth*, (*Galleria cereana*) which as a larva eats wax. There are two broods in a season.

*Hyponomeuta* has long maxillary palpi, and very long antennae, closely resembling some of the smaller Phryganids. The Tineids, generally, are moths of rare beauty. The family is one of great extent, and the species are very destructive to vegetation, and have innumerable modes of attack. Thus, *Tinea vestianella*, the clothes-moth, and allied species, construct a case of the fibers they eat, and bear it about for their protection. In June the moth appears and lays its eggs. *Tinea granella* make a silken web of the grains they devour. Another species, still more destructive in granaries is the Angoumois moth, (*Anacampsis cerealella*, FIG. 19. Fig. 19,) which secretes itself within the grain, devouring the mealy substance.



*Alucitæ*. This is a family comprising a few species whose wings are divided into numerous delicately

fringed branches. They are found in July and August, in herbage. *Pterophorus marginidactylus* is a common species, and flies in at light in July and August.

For collecting and preserving these minute and delicate moths, which are called by collectors, *micro-lepidoptera*, especial instructions are necessary. When the moth is taken in the net, it can be blown by the breath into the bottom. "Then by elevating the hand through the ring, or on a level with it, a *common cupping glass* of about two inches in diameter, or a *wine glass* carried in the pocket, is placed on the top of the left hand over the constricted portion, the grasp relaxed, and the insect permitted to escape through the opening into its interior. The glass is then closed below by the left hand on the outside of the net, and may be transferred to the top of the collecting box, when it can be quieted by chloroform." Clemens. Or the moth may be collected in pill boxes, and then carried home and opened into a larger box filled with the fumes of ether or benzine. In pinching any moths on the thorax, the form of that region is invariably distorted, and many of the scales removed. In searching for "*Micros*" we must look carefully on the *lee side* of trees, fences, hedges, and undulations in the ground, for they avoid the wind.

In seeking for the larvae we must remember that most of them are *leaf miners*, and their burrows are detected by the waved brown withered lines on the surface of leaves and their "*frass*" or excrement thrown out at one end. Some are found between united leaves, of which the upper is curved. Others construct portable cases which they draw about the trunks of trees, fences, &c. Others burrow in the stems of grass, or in fungi, toadstools, in the pith of currant or raspberry bushes. Most are solitary, a few gregarious. A bush stripped of leaves and covered with webs, if not done by *Clisiocampa*, (the American Tent Caterpillar,) will witness the work of a Tineid. Buds of unfolded herbs suffer from their attacks, such as the heads of composite flowers which are drawn together and consumed by their larvæ.

After some practice in rearing larvæ it will be found easier and more profitable to search for the leaf miners, and rear the perfect fresh and uninjured moths from them. In this way many species never found in the perfect state can be secured.

In raising *micro* larvae it is essential that the leaf in which they mine be preserved fresh for a long time. Thus a glass jar,

tumbler or jam-pot, the top of which has been ground to receive an air-tight glass cover, the bottom of which has been covered with moist white sand, will keep a leaf fresh for a week, and thus a larva in the summer will have to be fed but two or three times before it changes; and the moth can be seen through the glass without taking off the cover. Or a glass cylinder can be placed over a plant placed in wet sand, having the top covered with gauze. The pupae easily dry up; they should be kept moist, in tubes of glass closed at either end, through which the moth can be seen when disclosed. Instead of benzine, powdered and crushed *laurel* or *kalmia* leaves, which contain prussic acid, is often used instead of ether, chloroform or benzine.

*How to set micro-lepidoptera*: "If the insect is *very small* I hold it by its legs between the thumb and finger of the left hand, whilst I pierce it with the pin held between the thumb and finger of the right hand; if the insect is not very small I use a rough surface, as a piece of blotting-paper, or piece of cloth, for it to lie upon and prevent its slipping about, and then cautiously insert the point of the pin in the middle of the thorax, as nearly as possible in a vertical direction. As soon as the pin is fairly through the insect, remove it to a piece of soft cork, and by pressing it in, push the insect as far up the pin as is required.

"For setting the insects I find nothing answers as well as a piece of soft cork, papered with smooth paper, and with grooves cut to admit the bodies. The wings are placed in the required position by the setting needle, and are then retained in their places by a wedge-shaped thin paper brace, placed over them till a square brace of smooth card-board is placed over the ends of the wings." *Stainton*. Pieces of plate glass are often used instead of card-braces. Small slender insects pins No. 19 and 20, are made by Edleston & Williams, Crown Court, Cheapside, London.

#### DIPTERA.

North American flies have been but little studied, though so interesting and numerous. The different parts of the body vary greatly, and often give easy characters for discrimination. Thus the parts of the head, the form and disposition of the nervures and the interspaces of the wings, give good generic and specific differences. Their habits are very variable. Fresh water aquaria, consisting of glass jars with a few vegetables to oxygenate the

water, are necessary for the maintenance of aquatic larvae. If quantities of swamp mud and moss with decaying matter is kept in boxes and jars, multitudes of small flies will be hatched out. Leaf mining species can be treated as micro-lepidoptera, and earth inhabiting larvae, like ordinary caterpillars. Dung, mould in hollow trees, stems of plants and toad stools contain numerous larvae or *maggots*, as the young of flies are called, which must be kept in damp boxes.

Flies can be pinned alive, without killing them by pressure, which destroys their form; and numbers may be killed at once by moistening the bottom of the collecting box with creosote, benzine or ether. Minute species can be pinned with minute No. 19 or 20 pins, or pieces of fine silver wire, and stuck into pieces of pith, which can be placed high up on a large pin. In this way the specimen can be handled without danger of breaking. Small moths can be treated in this way. In pinning long legged, slender species, run a piece of card or paper up under their bodies upon which their legs may expand, and thus prevent their loss by breakage.

Of these insects, as with all others, duplicates in all the stages of growth, should be preserved in alcohol, as the minute species often dry up unless put in homeopathic vials.

*Culicidæ*. *Mosquitoes*, Gnats, have the mouth parts produced into a proboscis half as long as the insects themselves, which they can push into the skin. The females lay their eggs in a boat-shaped mass, which floats on the surface of the water, and in the spring the larvae are seen in pools by thousands, jerking themselves up and down in the water, after protruding a star-like respiratory organ above the surface to obtain a supply of fresh air. The pupae are club-shaped, with very large heads, to which two respiratory feeler-like organs are attached. There are several generations in a season. A large four-spotted species, (*Anopheles quadrimaculatus*) is abundant very early in spring and late in the fall. There are several genera and species of this family.

*Tipulidæ*. (Daddy-long-legs. Crane-flies.) The long palpi and antennae, slender body and very long legs of the members of this family, make them well known. The smaller species belong to the genus *Chironomus*, which is mosquito-like, with feathered antennae, and abounds in swarms in early spring. Their larvae are worm-like, of a blood-red color, and are found in the bottom of ponds.



*Ceratopogon*, like the musquito, is a blood-sucker, has the male antennæ partially feathered, and the larvæ live in mushrooms, or under the bark of decaying trees.

*Cecidomyia*. Gall flies have slender bodies and verticillate antennæ, their wings have few nervures, and are placed roof-like over the body. The female lays her eggs in the stalks of cereals, and of stems and leaves, which produce galls inhabited by maggots. The Hessian fly does not; however, produce an enlargement of the stalk, as is usual. Those species injurious to wheat, &c., can be collected by sweeping the fields in the spring, at evening, when they are laying their eggs.

*Psychoda* is a minute genus, with white, broad, oval wings, which is found flying about and into, little pools, and in great numbers on windows. The larvæ live in dung.

The *Mycetophilidæ* are of small size, and very active, leaping little flies, which are found in damp places. The larvæ are long, nearly round, white or yellowish; they are gregarious, living in decaying vegetable matter, fungi, or in dung, one species forming a gall. *Rhyphus* is common on windows; it has rather broad, spotted wings, and the larva lives in cow dung. The large *Tipulæ*, which fly all the summer and form a numerous group, live as larvæ in the mould of gardens, at the roots of willows, and in rotten wood. The pupa have the margins of the rings spiny, to be able to push themselves along, as do many other Diptera. Other species are aquatic, and should be raised in aquaria. *Chionea*, the snow-gnat, looks like a spider, being wingless, and is found in March on the snow.

The *Bibionidæ* comprise species very injurious from their feeding on the roots of grass; the thorax is stout, and the legs are short. *B. albipennis* flies in swarms in June and October, alighting slowly on the passer-by. *Simulium*, the black fly, has a stout body and short legs, often silvery in color. It is aquatic, its larva living on the stems of plants.

*Stratiomyidæ*. The insects of the following families have broad bodies, and short, bristle-like antennæ, the basal joints being enlarged. Those of this family are found among herbage in damp places. The larvae live in the water, in decaying substances or dung.

*Tabanidæ*, Horse-flies. The parts of the mouth are here again converted into a proboscis. The horse-flies are of large size, and troublesome from their formidable bite. Their eyes are very large,

and the thorax large and oblong-square. They abound in pastures and woods. Their larvae live in the earth. The species of *Chrysops*, the golden-eyed breeze fly, are very troublesome, as they fly about one's head unceasingly, striving to alight and draw the blood. The following genera represent families of small extent. *Anthrax* is rather broad and flat bodied, with a round head, gaily colored with yellow and black, the wings often partially black; it frequents sunny paths, flying with great swiftness. *Bombylius* has the body covered with long hairs, which gives the genus an oval outline, with slender legs. They are exceedingly swift on the wing, and are found in sunny paths and glades early in the spring, and can only be taken when lighted on the ground.

*Leptis* has large palpi, a fleshy proboscis and elongated form. Their bodies are often spotted, and the wings also spotted or banded. They are found resting on flowers and shaded sides of trees. The larvae are footless grubs, which widen gradually towards the terminal segment, which has two short appendages. The larva of an European species entraps other insects in holes in the sand, like the ant-lion, and is three years in coming to the perfect state.

*Midas* is a genus of large size, *M. clavatus* being banded with orange, and expanding over two inches. It flies in July and August. The larva, according to Harris, is white, cylindrical, tapering before and almost rounded behind. Two breathing pores are situated in the last ring but one. The pupa is brown, nearly cylindrical, and provided with a forked tail. It lives in decayed logs and stumps.

*Asilus* comprises several species, which have long, slender bodies, a rather stout thorax, and are covered with short, stiff hairs, variously colored. They are rapacious, seizing other insects and flying off with them like the sand-wasps. *Proctacanthus philadelphicus* is a very large, dark species, which frequents sunny places. The larva of *A. sericeus* lives on the roots of the rhubarb plant. It is three-quarters of an inch long, cylindrical nearly, and tapering at either end. Their pupa cases, with forked tails, are found sticking out of the ground and the roots.

*Laphria* is one of the same family, though the body is much stouter and more densely covered with yellow and black hairs. Indeed, in their loud buzz, swift flight and appearance they closely resemble bumble bees. They are found in sunny places, preying upon other insects.

*Syrphidæ*. These gaily colored flies, so useful to agriculture

from their habit of feeding upon plant lice, are very like the hymenoptera in form and coloration, having hemispherical heads, rather flattened bodies, ornamented with yellow bands and spots; they hover in the hot sun over and about flowers, resting upon them to feed upon their sweets. The eggs are laid among a group of plant lice, which hatch out footless, eyeless, flattened grubs, having extensile bodies to reach up and grasp the Aphis by their jaws, which are peculiarly modified for seizing their prey. They do great damage among these enemies of vegetation. The species of *Eristalis* which flies abundantly in May about the blossoms of gooseberries and currants, live in the water during their larval state, and are called rat-tailed maggots. The abdomen of *Conops* is pedunculated, while the thorax is globular like *Eumenes*, a genus of wasps.

FIG. 20.



*Empis* represents a small group of species that are allied in form to the Asilidæ. They are active flies, and very rapacious, seizing upon other insects and sucking out their juices. They often assemble in swarms.

*Dolichopus* and allies have long legs, and are generally green colored, and occur solitary in leaves or in damp situations, or in numbers flying and running on the surface of pools and running brooks, appearing very early in spring.

*Æstridæ*, (Bot-flies.) In these flies, which are of large size, the mouth parts are nearly obsolete, the flies themselves having thick bodies, covered thickly with hairs. The fly lays her eggs upon that part of the animal from which the larvae as they hatch out may find their way by some means to burrow in the back or stomach of the animal which they infest. From thence, when full grown, they escape and pass through their remaining changes in the earth. These grubs are very thick and soft, being broad oval, with rows of minute spines along the wings of the body to aid in locomotion. The Horse bot-fly larva is provided with hooks which are modified maxillæ, to enable it to maintain its position in the stomach of that animal. The Sheep bot-fly larva lives in the frontal sinus; and that of *Æstrus bovis* in the back of cattle, forming large open tumors.

*Muscidæ*. The common house fly, the blue bottle fly, and the flesh fly, at once recall the appearance of this family, one of great extent, and much subdivided by entomologists. The larvae are

in general footless, soft vermiform, ringed grubs, of a cylindrical-conic form, attenuated in front, and thickened and obtuse behind, with a head of variable form, furnished with two retractile hooks; the terminal segment of the body in many, and also that immediately succeeding the head, furnished with two spiracles, in some species inserted upon horn-like appendages. The pupa, which is very unmaturing in its form, with a swollen head, is enclosed within the contracted and indurated skin of the larva, which sometimes assumes the form of an oval, horny exarticulate mass, but in other species retains more of its former appearance." *Westwood*.

*Tachina* is parasitic upon caterpillars, and destroys great numbers in the same way as Ichneumons. Some of them are parasitic in the nests of bees. *Sarcophaga*, the flesh fly, is viviparous, the larvae being placed upon the meat by the parent fly.

*Musca Caesar*, the blue bottle, and *vomitioria*, the flesh fly, lay their eggs also upon meat and decaying animal matter, the larvae developing with great rapidity. The larvae of the House fly live in dung. *Anthomyia raphani* is the grub that attacks the radish roots. Other species live in onions, turnips, and the pulpy parts of leaves, and in rotten substances and dung. The species are very numerous; they are rather small and fly feebly.

*Ortalis* and allies produce galls in plants, or lay their eggs in fruit, such as raspberries, &c. They are found in shady places; their wings are generally spotted. *Tephritis asteris* causes the large swellings in the stems of tall asters. *Oscinis*, in Europe, does great damage to cereals by laying its eggs in the flowers of grain, the larva afterwards consuming the grain itself. Thus by collecting heads of wheat and composite flowers and keeping them in boxes, &c., these flies may be reared, and much light thrown upon their history and modes of attack. Many of these small flies, like the micro-lepidoptera, are leaf-miners, and can scarcely be distinguished from them when in the larva state.

*Hippoboscidae*, (Spider-flies.) These are small, flat-bodied flies, of disgusting appearance and habits, which by their large clawed legs run over the surface of quadrupeds and birds with great agility, burying themselves in the fur or feathers.

*Nycteribia*, or Bat-tick, is a wingless genus, with long legs and a spider-like body, and has similar habits to the Hippoboscidae. *Melophagus ovis* is the Sheep-tick. "These singular creatures are not produced from eggs, in the usual way among insects, but are

brought forth in the pupa state, enclosed in the egg-shaped skin of the larva, which is nearly as large as the body of the parent insect. This egg-like body is soft and white at first, but soon becomes hard and brown. It is notched at one end, and out of this notched part the enclosed insect makes its way, when it arrives at maturity." This species is probably viviparous, and the larvae are hatched within the body of the parent.

*Pulicidae.* Fleas are but wingless flies, with hard, compressed bodies, a long, sucker-like arrangement of their mouth-parts, and large hind legs, formed for leaping. Their metamorphosis is complete, the larvae hatched from eggs laid upon hairs, being worm-like, as in flies. They come to maturity in a few days; spin a sort of cocoon, and change to pupae, when the perfect insects appear in about ten days. Thus a generation may be produced in a month. Different species inhabit man, cats, dogs, &c. Those infesting the lower animals do not pass from one species to another.

#### COLEOPTERA.

Beetles have been studied much more than other insects; in this country there have been described some 8,000 species, but from the difficulty of finding their larvae and carrying them through their successive stages of growth, the immature forms of but few native species are known. The family forms are easy to distinguish and characterize, the genera are based upon marked changes in the different parts of the body, which vary greatly, and some of the best characters lie in the relative size of the head pieces and those pieces that make up the flanks of the three thoracic rings, and the basal joints of the legs. The relative size and the sculpture of the body and of the elytra; and lastly, the coloration, which varies much among the individuals, afford good specific characters.

The most productive places for the occurrence of beetles are alluvial loams, covered with woods, or with rank vegetation, where at the roots of plants or upon their flowers; under leaves, logs and stones, under the bark of decaying trees, and in ditches and by the banks of streams, the species occur in greatest numbers. Grass lands, mosses and fungi, the surfaces of trees and dead animals, bones, chips, pieces of board and excrement, should be searched diligently. Many are thrown ashore in sea-wrack, or occur under the debris of freshets on river banks. Many Carabidae run on sandy shore. Very early in spring, stones can be upturned, ants

nests searched, and the waters be sifted for species not met with at other times of the year.

For beating bushes, a large strong ring-net should be made, with a stout bag of cotton cloth fifteen inches deep. This is a very serviceable net for many purposes. Vials of alcohol, a few quills stopped with cork, and close tin boxes for larvae and the fungi, &c., in which they live, should be provided; indeed, the collector should never be without a vial and box. Beetles should be collected largely in alcohol, and the colors do not change if pinned soon after being taken. Coleoptera should be placed

FIG. 21.

high up on the pin, (Fig. 21, *Curculio*,) as indeed all insects should. The pin should be stuck through the right elytron so that it shall come out beneath or between the middle and hind pair of legs. Small species should be pinned with No. 19 and 20 pins, which can be afterward mounted on high pins as described for flies. Many coleopterists gum small species, under a tenth of an inch long, upon a small triangular bit of card, placing them cross-wise with a cement of inspissated ox-gall, gum arabic and water, or gum mixed with a little sugar. The first mentioned cement is very convenient for mending broken specimens. Specimens thus gummed have some of the best generic characters often concealed, and hence fine pins seem best to mount them upon.



The specimens should be neatly set, in their natural postures. Some individuals should have their wings expanded to show the neurulation. Beetles are best arrayed in boxes lined with cork well smoothed and neatly papered, 12 by 9 inches square, and an inch and a half deep. These boxes can be put under cover.

*Cicindelidae*. The Tiger-beetle, has a large head, much broader than the prothorax, very long jaws, like curved scissors, and long slender legs. Their colors are green or darker, with purplish or metallic reflection, marked with light dots and stripes. They abound in sunny paths, and sandy shores of rivers, ponds, and of the ocean, flying and running swiftly. Capture them by throwing the bag net quickly over them after they are settled; when abundant remain still in one place, waiting for them to settle near you, thus saving time and trouble. If without a net, throw a handful of sand at one, and thus confuse and catch it in its endeavors to escape. The larvae are hideous in aspect: the head is large, with long jaws, the thoracic rings large and broad, and the 9th ring has a

tubercle and hook, by which the grub can climb up its hole, at the entrance of which it lies in wait for weaker insects. These holes are found in sandy banks frequented by the beetles. Either dig the larvae out, or thrust in a straw, which they will seize and often suffer themselves to be drawn out.

This and the four following families are carnivorous, benefiting agriculture from the immense numbers of insects they destroy.

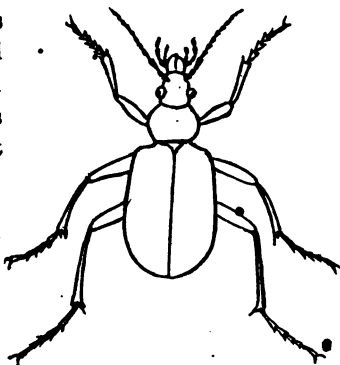
*Carabidæ*. In this group the head is narrower than the thorax, which is throughout as broad as the abdomen. The powerful jaws are shorter, and not curved as in the *Cicindelidæ*. The body is also flatter and more oblong. They are runners, the under wings being often absent. Their color generally dull. They run in grass, or lurk under stones and sticks, are under bark of trees, and under the debris of freshets, in the greatest numbers in spring. *Lebia* is found in Autumn on trees and tops of composite plants. *Amara* feeds on pith and stems of grasses. Others feed on wheat. They are often attracted by light. *Elaphus*, which is flat, and covered with coarse metallic punctures, runs on the mud flats of rivers, &c.

The larvae are found in much the same situations as the beetle and are oblong, broad, with the terminal ring armed with two horny appendages, and beneath a single tube-like false leg. They are black in color. The larva of *Calosoma* ascends trees to feed on caterpillars.

*C. scrutator*, (Fig. 22,) is our most splendid New England beetle of this family. It has not yet been found in Maine. *C. calidum*, our common golden spotted purple species, digs holes in fields where it lies in wait for its prey.

*Dysticidæ*, or Diving beetles, are, by their carnivorous habits closely allied to the *Carabidæ*. They are aquatic, flattened elliptical beetles, with their hind legs ciliated, forming a broad surface for swimming. In night time they leave the water and fly about. Their larvae are ferocious looking objects, and from their long curved jaws, and agile and stealthy habits, called Water Tigers. They prey on tadpoles and large insects. The beetles are most commonly found in

FIG. 22.



spring and fall. They can be raised, and their habits observed in Aquaria.

*Gyrinidae*, Whirl-gigs, are easily distinguished by their form and habits, being always seen in groups, gyrating and circling about on the surface of pools, and when caught giving out a disagreeable milky fluid. Their short antennae, short mandibles and two pair of ocelli, and bluish black colors, distinguish them from other aquatic beetles. Like the previous family, upon being disturbed, they suddenly dive to the bottom, holding on by their claws to submerged objects. They carry a bubble of air on the tip of their abdomen, and when the supply is exhausted, they rise for more. The larvae resemble a small centipede, with lateral ciliated filaments, serving as organs of respiration.

*Hydrophilæ*. Carnivorous as larvae, but when beetles, vegetable eaters, and living on refuse and decaying matter; this family unite the habits of the previous mentioned families, with those of the scavenger silphidae, &c. They are aquatic, small, convex oval, or hemispherical beetles. Their antennae are short, and their palpi are long and slender. The allies of the genus *Sphaerium*, live in excrements of herbivorous animals.

*Silphidae*, Carrion or Sexton beetles, are useful in burying decaying bodies in which they lay their eggs. Smaller species live in fungi, &c.; other genera live only in caves; *Catops* inhabits ants' nests. Another genus *Brathinus*, has been found from Lake Superior to Nova Scotia, about grass roots in wet places, and are small shiny insects of graceful form, according to Le Conte.

The group is distinguished by the knobbed antennae. Their larvae are crustaceous, flattened, the sides of the body often serrated, black and of a foetid smell; or those immersed in the midst of their food have weak limbs and soft bodies. The beetles can be caught on the wing in warm spring days, or taken at light in summer. By placing dead birds and small mammals, &c. in favorable places, they are allured in considerable numbers.

By the *Scydmaenidae* which are minute oval shiny brown insects found under stones near water, in ants nests and under bark, we pass to the *Pselaphidae*, with short elytra, much broader than the prothorax and head, with clavate antennae, and palpi nearly as long, which are found in spring in moss, or swept from herbage or taken while on the wing, we come to the *Staphylinidae* or Rove beetles, which are long, linear, black, with remarkably short elytra,



the abdomen beyond having 7 to 8 visible rings. Though sometimes an inch in length, they are more commonly minute, inhabiting wet places under stones, manure heaps, fungi, moss, under the surface of bark, or leaves of trees. Some burrow in sand, others form galleries under bark; *Stenus* is found running on mud, near water; *Micralymna* is found at low water mark in sea weeds in the larva state. Many species inhabit ants' nests, and should be carefully sought for on dewy mornings, under stones and pieces of wood, which should be taken up and shaken over a white cloth or paper; or the whole nest should be sifted through a rather coarse sieve, when the small beetles will fall through the meshes.

The larvae resemble the beetles, and are difficult to rear.

*Histeridae*. These beetles are square or oblong, hard, solid, shiny insects, black, with the prothorax hollowed out to receive the head, which has long prominent jaws. The elytra are usually striated. The antennae are elbowed, club shaped, and the legs are broad and thin. Others are oval and spotted. They are found in excrement and under bark of trees.

*Nitidulidae*. Broad oval or elliptical, depressed, the head also received into the excavated prothorax. The three last joints of the antennae are gathered into a broad club. Insects of small size, and found about rubbish, bones, &c. *Ips* has bright colors, often red, is one of the larger genera, and is found under bark and on the sour sap of stumps and trees in the spring. Others are found in fungi and in flowers. The larvae inhabit similar places. They are flattened oblong whitish grubs, the end of the abdomen has four horny conical upturned appendages. The pupae are found loose in rubbish and decaying wood, saw dust, &c.

Of similar form and habits is *Mycetophagus*, and other genera, representing families of small extent.

*Dermestidae*. Every entomologist dreads the ravages of *Dermestes* and *Anthrenus* in his cabinet. The ugly bristly insidious larvae which so skilfully hide in the body whose interior it consumes, leaving only the shell ready to fall to pieces at any jar, can be kept out only with great precautions. *Dermestes lardarius* is oblong oval, legs short, black, with the base of the elytra gray buff, covered by two broad lines. It is timid and slow in its movements, when disturbed seeking a shelter, or mimicking death. *Anthrenus musaeorum* is round oval, with transverse waved lines. Its larva is thick, with long bristles, which are largest on the end

of the body. They eat also the integuments of stuffed specimens, doing great injury. Boxes and drawers should be tight enough to keep them out, or it may be done with camphor or benzine in a sponge or in cotton. Collections which are much infected should be baked.

*Byrrhus*, which is short, thick convex, is found under stems and on leaves. When disturbed it counterfeits death. Larvæ long, narrow, oblong. By the small group of Byrrhidae we pass to one of immense extent, and of great importance to agriculturists from the great injury they do as leaf-eaters.

*Scarabeidæ*, or Lamellicornes, are distinguished by their lamellated antennae, short broad, thick convex form; their legs are flattened, and toothed for the purpose of digging. The tip of the abdomen is generally exposed. The males are often armed with horns on the clypeus. Colors black, dull or shiny, coppery or gaily ornamented. Among them occur tropical insects, such as the Goliath beetles, which are the largest of insects. *Lucanus* has immense jaws; in the males they are like deer's horns. The larva forms a cocoon of the chips it has made in boring into decaying trees. The larvae are thick, cylindrical, soft fleshy grubs, the abdomen incurved, so that the grub lays on its side, the legs being short and weak. They live several years.

*Aphodius* is a small semicylindrical genus, flying about ordure in spring; of similar habits is *Geotrupes*, a large green or purplish colored genus. *Copris*, called Tumble Dungs, enclose their eggs in pellets of excrement.

*Melolontha* and allies are leaf eaters, which have long-clawed legs to cling on to leaves, where they are found early in summer. Their larvae eat the roots of grass, and before transforming, form oval earthen cocoons. *Macrodactylus*, the Rose beetle, is found on roses and rhubarb blossoms in gardens.

*Lachnosterna*, the June bug, does much injury to apple and cherry trees. The males fly in evening in search of the other sex. The large grubs are turned up abundantly in spring, in gardens. Skunks feed upon them, and smaller species are eaten by toads, indeed many rare species of beetles have been found in the stomach of toads and insectivorous birds.

*Buprestidæ*. Beetles, with elongate, flattened, very solid bodies, often angulated, the antennae slender and serrated, legs short. The head is received into the excavated prothorax. Colors bril-

liant, often metallic. On being disturbed, the insects draw up their legs and feign death. They creep slowly, flying in the hot sun, and feed on wood, flowers and sap; being found especially on fir trees. They should be sought for while sunning themselves on trunks of trees, where they lay their eggs.

The larvae are also elongated, the thorax is broad, while the abdomen may be equally broad, or narrow and cylindrical. They are wood borers, and live in this state several years.

*Chalcophora virginica* is common in May and June. *Dicerca* has the tip of abdomen divided. *Chrysobothris* lives in the apple tree.

*Elateridae*, or Snapping beetles, are known to many by their power of righting themselves when turned on their backs, by jerking themselves up into the air, since their legs are too short to catch hold of the surface they are upon. They are of a very uniform elongate ellipsoid form, somewhat flattened, the head and prothorax rendered very distinct by a depression of the base of the elytra. Colors are obscure brown, sometimes green with metallic reflections.

They frequent the flowers of *Viburnum*, of rhubarb in gardens, and are found under bark. The *Eucnemidae* are rare, being found under bark or on leaves. *Alaus oculatus*, is the larger ocellated species. The larvae are called *wire-worms* from their long cylindrical form. They feed on the roots of grass, grain, &c., often devour turnips, salad, cabbages and pinks, living in the interior of these stems. Moles devour great quantities of them. Other species inhabit rotten stumps. They live several years in this state.

We pass over several smaller groups to the

*Lampyridae*, or Glow worm. They resemble the Elaters, but are shorter and broader, and of softer consistence.

The species of *Ellychnia* are found early in spring and fall, on trunks of trees, and they winter under the bark.

The female glow worm is apterous, and resembles the larvae; the end of the abdomen is light colored, and at night this portion sheds a brilliant light at its will. Winged females of other genera emitting a bright light, appear on low grounds in the evenings, at the middle of June. *Drilus* is distinguished by the plumose antennae. The larvae are flatted, the margin of their bodies is serrated, and they are soft and black in color. They are carnivorous

and feed on snails, and are found in places frequented by these mollusks, as at the roots of alders and willows, under the bog moss.

*Eurypalpus LeContei* is an anomaly, since it lives under stones in rivers and brooks, being oval hemispherical as a larva, the sides of the body greatly extended, resembling some species of crustacea. The beetles are narrow and rather short. The species of *Telephorus* live on leaves of plants, especially the birch. They are carnivorous, often feeding upon each other.

We pass by the *Malachidæ* to the

*Cleridæ*, which are beetles whose larvae are carnivorous. They are cylindrical, the prothorax narrower than the head. They are fast runners, and run like ants, which they much resemble, over flowers and trees, to feed on the sweets and sap. *Trichodes nuttallii* is blue and red, and found on the flowers of Golden rods and Spiraea. The narrow long pink-colored larvae of *Thanasimus* can be found under the bark of dead pine trees, where it devours the larvae of *Hylurgus* and *Hylobius*; *Clerus* and allies are found in bumble bees' nests. In Europe they have been found infesting the nests of mason bees (*Osmia* and *Megachile*).

*Ptinidæ*. They also infest herbariums and museums. They are small beetles, of an obscure brown color, somewhat oval, behind truncated, the prothorax slender and receiving the head. The antennae are long and filiform, and in constant motion when the insect walks. Upon being disturbed it feigns death. They are found about out-houses. *Ptinus fur* has done great mischief in eating wheat. *Anobius* is the Death-tick; the females strike their jaws on the surface of walls, to attract the other sex in the pairing season. The larva are also supposed to make the same noise. When about to change to pupae, they construct silken cocoons. *Bostrichus*, lives in fungi and under bark; *Ois* in toadstools; the larvae are fleshy white grubs.

The *Tenebrionidæ*, are apt to be confounded, by beginners, with Carabidæ, but the prothorax is much narrower than the abdomen, and the head is narrower still. Antennae clavate, feet short, of black or brown colors. The surface is smooth, in *Tenebrio*, or roughly corrugated in *Upis*. They are generally found under stones, logs, and in toad-stools. *T. molitor*, the meal worm, inhabits granaries. Ship bread is eaten by the larvae, which are "about an inch long, of cylindrical and lineal form, very smooth

and glossy, of a fulvous color." *Blaps* is found in moist places; other genera, under bark; *Phaleria*, on the sea shore. *Boletophagus*, as the name suggests, lives in fungi.

Passing over several small groups we come to the

*Mordellidae*, which are wedge-shaped, small, glistening pubescent black beetles, which occur in abundance on the flowers of golden rod and asters, and when disturbed leap like fleas. The larvae of *Mordella* are found in the pith of plants in autumn, and are long, subcylindrical, the sides of the rings furnished with fleshy tubercles.

*Meloidae*. This and the following family are most interesting, from their parasitic habits, and demand careful study and observation. *Meloe augusticollis*, is an inch long, thorax very small, square; abdomen large and swollen; the elytra are small and oval. The antennae of the male are crooked in the middle. It is of a deep Prussian blue. It feeds on grass in the spring, in the summer it is found in the White Mountains, feeding on *Clintonia borealis*. The larva is very different from the beetle, and as found parasitic on wild bees, resembles larvae of some *Staphylinidae*, being oblong, flattened; the three thoracic rings above, of nearly equal size, transversely oblong, the head nearly of the same size, with short antennae; the legs have very long claws, with an intermediate long pad. From the tip of the abdomen proceed two pairs of setae of unequal length. They are found living upon bees between the joints of the head and thorax, their heads immersed in the dense scales of the bee. In Europe this genus has been found parasitic on *Cetonia*. Our *Cetonia Inda*, and other related beetles should be searched for them. The eggs are laid on the ground, and the active larvae attach themselves soon after hatching, to bees, and to the *Syrphus* flies, and *Muscae*.

*Cantharis* and our *Epicauta*, secrete cantharidine, of use in pharmacy. *E. atrata*, is found in abundance on golden rod, and it is perfectly black, with long elytra. *Rhipiphorus*, is parasitic on the wasp; *Ripidia* on *Blatta americana*, the cockroach.

*Stylopidae*. The larvae of this most anomalous family are much like that of *Meloe*. They are oval in form. The perfect insects are not a quarter of an inch long. The elytra are pad-like, while the hind wings are greatly developed, expanding broadly, folding when the insect is at rest, along the body. They live but a short time in the perfect state. "They are parasitic in the bodies of

species belonging to various genera of aculeate Hymenoptera ; the comparatively large size of these parasites, causes a distension of the abdomen of the Hymenopteron affected, and, on close observation, the heads of the pupa cases may be seen emerging between the segments. The head of the pupa case of the male is convex, that of the female is flat ; specimens containing male pupae can be kept confined with proper food, until the parasite is hatched. *Stylops* inhabits bees, of the genus *Andraena*. I have never met with specimens. *Xenon Peckii*, lives in our common wasp *Polistes fuscata*. I have seen stylopized individuals of *Odynerus quadripornis*, and of a large species of *Sphex*."—*Le Conte*. *Stylops* has four joints, *Xenos*, six joints to the antennae. There is a species of *Xenos*, only found, thus far, in Nova Scotia, which must likewise occur in Maine. They are found at different seasons of the year, but mostly in April and May. They have been taken by sweeping grass in August.

The three following families are of great extent, and do great mischief to agriculturists, by the great variety in their modes of attack upon plants.

*Curculionidae*—(See Fig. 21.) This group is at once recognized, by having the head lengthened into a long snout, near the middle of which are situated the elbowed antennae. Their bodies are hard and round, and often very minute in size. The beetles are very timid, and quickly feign death. The larvae are white, thick, fleshy, legless grubs, with tubercles, instead of limbs, and armed with thick, arched, strong jaws. They feed on nuts, seeds, the pith of plants, leaves or flowers ; while some are leaf miners, and others make galls. Before they transform they spin a silky cocoon.

*Bruchus pisi* is short and oblong, it lays its eggs on the pea, when in flower, and lives in the pea till the following spring.

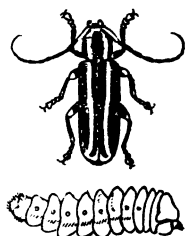
*Anthribus* is parasitic in the body of *Coccus*. *Brenthus* inhabits the solid trunks of oaks. *Apion* inhabits the seeds of clover. *Hylobius pales* is found under the bark of the pine, where *Pissodes strobi* in all its stages occurs. *Rhynchaenus nenuphar* infests the plum. *Calandra granaria*, the grain weevil, is an eighth of an inch long, and consumes the interior of wheat. *Balaninus* forms galls on the willow. *Scolytus*, *Xyloterus* and *Tomicus* are cylindrical bark borers ; "they form galleries in the bark, or sap wood, often causing the disease called fire blight."

*Cerambycidae*. The Longicorns are insects with long bodies,

tapering behind; the elytra broader than the prothorax, the antennae and legs very long, and are large handsome beetles, often gaily ornamented. They fly in hot days about woods and timber. *Orthosoma cylindricum* flies into houses at light in the evening. *Prionus*, and allies, are large, dull colored, flattened beetles, which fly in the evening. The larva is broad and flattened, the head can be drawn in the prothorax farther than usual. It forms cocoons of the chips it makes. *Asemum* flies in hot days, often in great numbers.

*Cerambyx*, and allies, have the antennae very long; and are highly colored. They are found in trunks of trees, or flying clumsily among the leaves. *Clytus speciosus*, bores in the locust. *Saperda candida*, (Fig. 23.) is the apple tree borer. A species of *Staphylinus* is, in Europe, parasitic upon one of this genus. *Stenocorus putator*, the oak pruner, severs the twigs of that tree, by eating the wood under the bark, which the wind breaks off.

FIG. 23.



*Leptura* and the neighboring genera, narrow rapidly at the hinder portion of their bodies, the antennae are rather short, and they occur on flowers, such as *Spiraea*, &c. *Rhagium lineatum* has a flattened larva which can be found under the bark of pines, in large cells formed of its chips. *Desmocerus palliatus*, the "Purple cloak," is found boring in the pith of elders.

*Chrysomelidæ*. The insects of this family have hemispherical or oval convex bodies, with small heads sunken in the thorax, and live in all their stages on the leaves of plants. The larvæ have thick bodies, the rings composing it are very convex, and above marked with tubercles and thickened deposits; they are often gaily colored.

*Donacia*, which approaches the *Cerambycidæ* in its elongated body and long antennæ, lives as a larva in the stems of aquatic plants; the pupa is found in silken cocoons attached to the roots of the submerged plants. *Lema trilineata*, which closely resembles the squash beetle, devours the leaves of the potato. *Cassida*, or the Tortoise beetle, is round, depressed, and yellow. Its larva is broad and flattened, with lateral ciliated filaments, and its abdomen is produced into a tail which it holds loaded with its excrement, over its back for purposes of concealment and defence. *Hispia* is a leaf

miner, its minute larva making galleries in the leaves of the apple tree, and wild cherry. *Galeruca vittata*, the squash beetle, is yellow with black stripes. The different species of *Haltica* or flea beetles, are little, black colored, most hurtful insects, which destroy young tomatoes, turnips, &c. Several species of *Calligrapha* are found on alders, they are oval and richly ornamented with dots and curved lines.

*Chlamys*, which is an oblong square beetle, has its convex surface most curiously corrugated; as a larva it lives in a cylindrical case on the sweet fern.

*Coccinellidae* (Lady bugs.) They are hemispherical, generally red or yellow, with round or lunate black spots. *Chilocorus* is black with yellow dots. The eggs are laid, often, in a group of plant lice, or Aphides; as soon as hatched the larvae devour them. When about to turn to pupae, they attach themselves by their terminal rings to the leaf they are upon. The beetle is as voracious as the larva. In Europe gardeners take pains to collect and put them on trees infested by lice, which they will soon remove. *Coccinella novemnotata*, (Fig. 24,) is a common species in gardens.

FIG. 24.



#### ORTHOPTERA.

In studying these insects, the proportion of the head, of the prothorax, of the wings, of the hind legs, and the external genital parts, should especially be taken into account. The ornamentation varies greatly even in the same species, and therefore large numbers of individuals are necessary to ensure a proper knowledge of any species.

The transformation of grasshoppers need careful study. For this purpose their eggs should be sought for, and the development of the embryo in the egg be noted; also the following facts should be ascertained: the date of deposition of the eggs; the manner of laying them; how long before the embryo is hatched; the date of hatching; how many days the pupa lives; also so of the pupa and of the imago, while the intervening changes should be carefully observed. Crows and blackbirds feed on their eggs and larvae, and hens and turkeys feed greedily upon young and old. Ichneumon parasites prey upon them, and also the lower worms, such as *Filaria*, *Gregarina* and *Gordius* and red mites, attack them. Mud wasps provision their nests with their young.



Orthoptera can be easily preserved in strong alcohol, and can afterwards be taken out and pinned and set at leisure. They can be killed with ether or benzine, as coleoptera, without losing their colors, as they would do, after remaining long in alcohol. They should be pinned through a little triangular spot between the bases of the elytra or fore wings, when the wings can be spread to advantage. They are also often pinned through the prothorax, or through the right elytra, as in coleoptera. In pinning these insects for transportation, care should be taken to put in additional pins on each side of the abdomen, and in like manner to steady the hind legs, which are very apt to fall off if too much jarred.

The different sounds produced by Orthoptera should be carefully studied; every species can be distinguished by its peculiar note, and as in different families the musical apparatus varies, so each family has a characteristic chirrup, or shrilling, or harsh, grating, rasping noise.

*Forficulidae*, Earwigs. Narrow, flattened insects, very unlike other Orthoptera, with short wing covers, like the Staphylinids among beetles; terminal ring armed with a pair of very long incurved forceps-like horny pieces; nocturnal insects, hiding in the daytime between leaves and in flowers, flying about at dark. They feed on the corollas of flowers and on fruit; they will eat bread and meat, &c., and are very troublesome in Europe. Our species has not yet been found in Maine, though inhabiting other parts of New England. An Alpine species lives under stones in Europe.

*Blattariae*, Cockroaches. Also nocturnal, hiding by day, or as in the wild species, under stones, &c. They are fond of heat. While troublesome from eating garments, &c., they do great service in clearing houses and vessels of bed-bugs, which they prey upon. We have several species in New England which should be carefully sought after. They are found under stones, and are smaller than the house cockroach. They are oval, the head rounded and partially concealed, with long antennae. The fore wings are thickened, the anal stylets short. Color almost invariably a reddish brown. The eggs are laid in large bean-shaped capsules, which are divided into two apartments, each containing a row of separate chambers, about thirty in number, and each enclosing an egg. Many days are required for oviposition. An English writer has stated that in *Blatta* and a species of *Phasma* the larva and pupa state are undergone before leaving the eggs, so that the changes

of the hatching belong to the imago state. Future observation must show whether this be generally the case in this suborder. Various Ichneumons feed on the eggs.

*Phasmidae, Walking sticks.* Our New England *Diaphomera femorata* is four inches long; linear, wings minute, legs very long and linear, and is found in trees, rose bushes, &c. It is very sluggish and not easily distinguished from the twigs it may be resting upon. The eggs of this group are bean-shaped with scattered dots.

*Gryllodea.* Crickets are known by their dark colors, depressed oblong form, and long anal stylets, and by their long antennae. The female has an ovipositor nearly as long as her body. They are ground insects and fast runners. The male chirrups to attract the other sex; the apparatus being a specialization of the membrane and nervures at the base of the wings, so that the rubbing of the wings one upon the other produces a rasping-like noise. The eggs are laid in cases, and the insects come to maturity in the fall. Our common black species is the *Gryllus neglectus*.

Gilbert White says of the English cricket: "When the males meet they will fight fiercely, as I found by some which I put into the crevices of a dry stone wall, where I should have been glad to have made them settle; for though they seemed distressed by being taken out of their knowledge, yet the first that got possession of the chinks, would seize upon any that were obtruded upon them with a vast row of serrated fangs. With their strong jaws, toothed like the shears of a lobster's claws, they perforate and round their curious regular cells, having no fore-claws to dig, like the mole-cricket. Of such herbs as grow before the mouth of their burrow they eat indiscriminately; and on a little platform which they make just by, they drop their dung; and never, in the daytime, stir more than two or three inches from home."

The mole cricket, *Gryllotalpa*, live in wet, swampy soil, by ponds and streams, where they raise ridges, as they make their subterranean galleries in search of insects. Their fore legs are adapted like those of the mole for digging, and are stout and short, much flattened, and armed with solid, tooth-like projections. Their eggs are in a tough sack, containing two to four hundred, it is stated.

"As mole crickets often infest gardens by the sides of canals, they are unwelcome guests to the gardener, raising up ridges in their subterraneous progress, and rendering the walks unsightly. If they take to the kitchen quarters, they occasion great damage

among the plants and roots, by destroying whole beds of cabbages, young legumes and flowers. When dug out, they seem very slow and helpless, and make no use of their wings by day; but at night they come abroad and make long excursions, as I have been convinced by finding stragglers, in a morning, in improbable places. In fine weather, about the middle of April, and just at the close of the day, they begin to solace themselves with a low, dull, jarring note, continued for a long time without interruption, and not unlike the chattering of the fern owl or goat-sucker, but more inward.

"About the beginning of May they lay their eggs, as I was once an eye-witness; for a gardener at a house where I was on a visit, happening to be mowing on the sixth of that month, by the side of a canal, his scythe struck too deep, pared off a large piece of tuft, and laid open to view a curious scene of domestic economy. There were many cavern and winding passages leading to a kind of chamber, neatly smoothed and rounded, and about the size of a moderate snuff box. Within this secret nursery were deposited nearly an hundred eggs, of a dirty yellow color, and enveloped in a tough skin; but too lately excluded to contain any rudiments of young, being full of a viscid substance. The eggs lay but shallow, and within the influence of the sun, just under a little heap of fresh moved mould, like that which is raised by ants.

"When mole-crickets fly, they move *cursu undoso*, rising and falling in curves." *White*.

Nothing is known about our New England species, of which we have more than in Europe.

*Ecanthus niveus*, is very flat and broad behind, with long legs, and white, colored with yellow; the female is narrower and tinged with green. They live on grape vines, and are easily detected by their loud shrilling. They lay their eggs in the stems of plants, by perforating the stalks with their ovipositor, and they have been found thus perforating the branches of peach trees; they also feed upon the tobacco leaves. It has not yet been observed in Maine.

*Locustariae*, are large, generally broad-winged grasshoppers, with long, slender legs. The Katydid belongs to this family. It has not yet been found in Maine. But its allies which live in bushes and on trees, such as the large *Phaneroptera angustifolia*, and which make a loud, shrilling noise, are common.

*Ceuthophilus maculatus*, a wingless species, of a dark brown color, is common under stones; in other parts of the country they are

found in caves. A different species from the *maculatus* inhabits the island of Grand Manan.

*Acrydii*. The common grasshoppers have large heads, rather short and thick antennae, thick, compressed bodies, and the prothorax projects backward conspicuously, and is often divided by crosswise impressions. The hind legs are stout and thick, adapted to the leaping habits of the insects.

*Locusta corallina* appears for about two weeks in May in dry fields. *L. sulphurea* and *carolina*, the "quakers," are fall insects; so are the different species of *Chlocæltis*, which survive the frosts till late into November. They produce their chirring noise by rubbing their thighs on the wing covers. Red mites are frequently found sucking the juices beneath the wings. The species of *Tettix* are small, but prodigious leapers, and are characterized by having the prothorax carried out to the end of the abdomen. Toads and frogs devour large numbers of grasshoppers.

#### HEMIPTERA.

This suborder has been greatly neglected; these insects are not the favorites of entomologists. In studying the different groups the investigator is aided by the great variation in the general proportions of the body; in the shape and relative size of the head and its appendages. The species are subject to great individual variation, which should caution the student in drawing the limits between them.

Aquatic species should be taken out by the water-net by thrusting it under swimming species, or pushing it among submerged grass or weeds where small species are lurking. Several species of small size are found under logs, &c., in the water. By sweeping grass and herbage as for coleoptera in the last part of the summer, large numbers occur which can only be obtained in this way. Hibernating species are found under leaves in hard wood forests. The large carnivorous kinds are found on bushes frequently with lepidopterous larvae transfixed on their jaws.

The soft bodied species of *Aphis* and allies should be preserved in alcohol. These species should be carefully watched for their parasites, and can be easily kept in slender glass vials through which the insects can be watched. All hemiptera should be pinned through the distinct triangular scutellum in the middle at the base of the wings. The minute hard species of *Tettigoniae*, *Thrips* and

small Capsidae, may be stuck upon cards as in the coleoptera. When on a collecting tour they can all be thrown into alcohol, and taken out afterwards and pinned and set.

*Thripadae*. This family has by some authors been considered to form a distinct order called *Thysanoptera*. They are minute, narrow and flattened insects, very active in their habits, are found in flowers, especially composite plants, such as the White-weed, and when running over the hand cause a severe itching. There are two pairs of long narrow wings without any nerv-ures, which are delicately fringed on the margin, and are laid one above the other over the body. The mouth parts are free, but the mandibles are like two bristles, the maxillae are flat triangular, bearing a pair of palpi. These parts are partially united into a conicle sucker which is folded upon the breast. The prothorax is largely developed; the legs are short, and the elongated abdomen terminates in several long bristles which are closely united together.

Some species are wingless, being found under the bark of trees. They closely resemble their larvae (Fig. 25), which are found in the same situations as the perfect insects, and are distinguished from them by the uniformity of the three thoracic rings, and their similarity to those of the abdomen; by their softer body, and shorter antennae and legs, and the want of simple eyes. They are often pale yellow, blood red and flesh color. The pupae have "the limbs obscured by a film, and the wings enclosed in a short fixed sheath. The antennae are turned back on the head, and the insect, though it moves about, is much more sluggish than in the other states."



The species are very injurious to flowers, eating holes in the corollas, and sucking the sap from the flowers of wheat, in the bottom of which they hide.

*Cicadidde*, commonly called "locusts," are large wedge-shaped insects, with a large broad head, prominent eyes, their ocelli on top; wings transparent with thick veins. The males have a musical apparatus beneath the wings on the hinder ring of the thorax, which acts like a kettle drum, producing the loud, penetrating, shrill sound issuing apparently from trees. *Cicada rimosa*, our smallest species in Maine, begins to be heard a little before the middle of June. The *C. canicularis* is larger and comes later, being an autumnal species. Mr. Verrill has observed this species in

Norway laying its eggs in the stems of *Solidago* or Golden Rod. It made a longitudinal incision with ragged edges into the pith of the plant, then with its ovipositor forced its eggs some distance down in the pith below the outer opening; there were two rows of eggs succeeding the first single one, each pair diverging outwards, the lower ends of each pair nearly touching each other, and all the pairs were placed very near together. The habits of the seventeen year locust which does not inhabit Northern New England, are well described by Dr. Harris in his Treatise. The young larvae feed on the roots of the oak and apple, clustering upon the roots, and sucking the sap with their beak-like mouth.

*Membranicipidae*. Antennae three-jointed; head broad, with two ocelli. The insects of this family assume the most grotesque forms. They are great leapers. *Ceresa* is broad, wedge shaped, green or brown color, and two species are found in great profusion in bushes in August and September. Different species of *Eutilia*, which are often notched upon the back, are found upon the stems of golden rods and birches, and closely resemble the surface they are upon. They lay masses of white eggs on the plants they frequent. *Classoptera proteus*, convex above and in front and highly colored, is injurious to the cranberry in Massachusetts. It is a common Maine insect.

*Tettigonidae*.—Leaf-hoppers. They pass all their lives on the leaves of plants, inserting their beaks into the leaves and sucking the sap, thus causing the leaves to wither and also the twigs, producing what is called "Fire-blight," having much the same effect that the *Scolytus* produces.

The species of this family are very numerous, and are found hopping on leaves and herbage late in the summer, though a few species are among the earliest spring insects. There are some yellowish species found in moss and grass by the side of pools and puddles in woods just as the snow is going off. The eggs are laid in autumn to be hatched in the spring. A very abundant species on grass, producing what is called "frog spittle," can easily be traced through all its changes by frequently examining the froth which surrounds them. *Tettigonia vitis* is a tenth of an inch long, straw yellow striped with red; it lays its eggs in summer and hides among the dead leaves during the winter. *T. rosae*, a still smaller species, is found on the rose. As a family these insects are characterized generally by their oblong outline, being convex

above, the head somewhat triangular or crescent shaped, the prothorax is large and of the same width as the body, and the legs are thickly spined.

*Aphidae*. Every thing about this extensive group is of the greatest interest, whether it be their structure, mode of growth or habits and relations to other insects. They have soft oval bodies, with two slender tubercles behind, with somewhat square heads and long slender seven-jointed antennae. The beak is often half as long as the body. They are generally colored green, and often have a soft bloom upon the surface. "The brief history of the general conditions of the development of these insects is as follows:—In the early autumn the colonies of plant-lice are composed of both male and female individuals; these pair, the males then die, and the females begin to deposit their eggs, after which they die also. Early in the spring, as soon as the sap begins to flow, these eggs are hatched, and the young lice immediately begin to pump up sap from the tender leaves and shoots, increase rapidly in size, and in a short time come to maturity. In this state it is found that the whole brood, without a single exception, consists solely of females, or rather, and more properly, of individuals which are capable of reproducing their kind. This reproduction takes place by a viviparous generation, there being found in the individuals in question, young lice, which, when capable of entering upon individual life, escape from their progenitors, and form a new and greatly increased colony. This second generation pursues the same course as the first, the individuals of which it is composed being, like those of the first, sexless, or at least without any trace of the male sex throughout. These same conditions are then repeated, and so on almost indefinitely, experiments having shown that the power of reproduction under such circumstances may be exercised, according to Bonnet, at least through nine generations, while Duvau obtained thus eleven generations in seven months, his generations being curtailed at this stage not by a failure of the reproductive power, but by the approach of winter; which killed his specimens; and Kyler even observed that a colony of *Aphis Dianthi*, which had been brought into a constantly heated room, continued to propagate for four years in this manner, without the intervention of males, and even in this instance it remains to be proved how much longer these phenomena might have been continued." Dr. Burnett, from whom we quote, considers this

anomalous way of increase of individuals as a process of *budding*, and that the whole series, like the leaves of a tree, constitutes but a single generation, which results from the union of the sexes in the previous fall. It has always been supposed that the final autumnal set of individuals were males and females alone. Hear Dr. Burnett again: "The terminal brood has hitherto been considered, as far as I am aware, to be composed exclusively of males and females, or, in other words, of perfect insects of both sexes. I was surprised therefore on examining the internal organs of the non-winged individuals, to find that many of these last were not females proper, but simply the ordinary gemmiferous form. Moreover so great was the similarity of appearance between these two forms—true females and gemmiferous individuals—that they could be distinguished only by an examination of their internal genitalia."

*Aphides*, (Fig. 26,) are found upon every part of plants. Some species which are wingless, are found on the roots of plants, others on the stems or twigs, others roll up leaves, or form gall-like swellings on leaves; the grain aphid sucks the sap of the kernel. Ants are fond of the sweet excretions from the abdominal stylets, and often keep them captives in their nests like herds of cattle. *Syrphus* flies, and *Coccinellae*, keep them within proper limits in nature. Minute species of *Aphidius*, small Ichneumons, kill larger numbers than we imagine. "When an aphid has received an egg from one of these parasites, it quits its companions and fastens itself by its unguis to the under side of a leaf, when it swells into a globular form, its skin stretched out and dried up, and in a short time the perfect parasite escapes by a circular hole, the mouth of which sometimes remains like a trap door."



*Eriosoma lanigerum*, the American blight, a woolly or cottony covered species, feed on the sap wood of the apple.

*Coccidae*, or bark lice, are scale-like in form like miniature oyster shells, and live on the bark of trees, or upon the roots. The males alone are winged and pass through the usual changes, while the female only increases in size, preserving its scale-like form. "Early in spring the bark lice are found apparently torpid, situated longitudinally in regard to the branch, the head upwards, and sticking by their flattened inferior surface closely to the bark. On attempting to remove them they are generally crushed, and there issues from



the body a dark colored fluid. By pricking them with a pin, they can be made to quit their hold, as I have often seen in the common species, *Coccus Hesperidum*, infesting the myrtle. A little later the body is more swelled, and, on carefully raising it with a knife, numerous oblong eggs will be discovered beneath it, and the insect appears dried up and dead, and only its outer skin remains, which forms a convex cover to its future progeny. Under this protecting shield the young are hatched, and, on the approach of warm weather, make their escape at the lower end of the shell, which is either slightly elevated or notched at this part. They then move with considerable activity, and disperse themselves over the young shoots or leaves." *Harris*.

The *cochineal* is prepared from the coccus that lives upon the cactus. In Canada a dye of equal value has been prepared to some extent from a native species of this genus. The minute scales secreting wax that cover certain species in the East Indies, enable the natives to prepare the different varieties of shellac.

The preceding families belong to the order *Hemiptera* of many writers, but it is difficult to draw the line between the two groups of families. As a general thing the following families have the head smaller, the antennae long, and the base of the fore wings thickened; the beak is longer; many of the species are carnivorous. These have by one author been divided into *flower-suckers* and *blood-suckers*. When disturbed they emit a disagreeable odor, and small species are often eaten with fruit, producing a particularly offensive and lasting taste. Various genera, such as *Velia*, *Gerris* and the *bed-bug*, often have no wings when merely perfect insects but pads instead, as all hemipters have when in the pupa state; but as the functions of reproduction are carried on, they have by some writers been called different species from the fully winged individuals:

*Notonectidae*, or water-boatmen, are like *Tettigoniae*, but their legs are ciliated and formed for swimming. The different species of *Corixa* are common in every pool. Their motions are rapid, diving suddenly to the bottom and holding on to submerged objects when disturbed. They fly well, but walk with difficulty.

*Nepidae*. This group comprises, among others, two singular genera. *Belostoma*, containing the largest species in the suborder, often measuring three inches in length. They may be seen in winter swimming beneath the ice of ponds. *Ranatra* is long linear,

a water walking-stick. The head is small, the forelegs enlarged and adapted for seizing insects, as they creep about the roots of aquatic plants.

*Hydrometridae*. The genus *Gerris* which represents this family in Maine, is long, narrowing alike towards both ends, being shaped like a wherry, and with their long legs they run over the surface of ponds and streams, moving backwards and forwards with great facility. They are among the earliest spring insects.

The following families are terrestrial, living for the most part on plants :

*Reduviidae*. Insects with rather long, somewhat flattened bodies ; the beak is much curved ; the head is narrowed behind ; the eyes are very prominent, and the prothorax is much raised in the middle, with a thin, often serrated ridge. The European *Reduvius personatus* feeds on bed-bugs, its larva and pupa concealed in a case of dust, the better to approach their prey. *Ploiaria* is very narrow, with very long legs ; it is common in gardens, and is found as late as the middle of November. *Nabis ferus* is stouter, and very common in gardens.

*Pentatomidae*. This is a large family of insects, of bright colors, and often of large size. The head is received into the large, broad, short prothorax, and the scutellum or the triangular piece at the base of the wings is large and distinct ; they are generally oval in form. They are found in shrubs, sucking the leaves, or often seizing some caterpillar with their hooks. De Geer describes the eggs as being generally of an oval form, attached to leaves at one end by a glutinous secretion, the other being furnished with a tap, which the larva busts off when it hatches out. The larvae are rounded oval.

*Coreidae*. These insects are narrower than the preceding group ; they are flat above, and beneath convex. They run and fly well, their habits being generally very active. They are the most gaily colored, perhaps, of hemiptera. The larvae differ very little from the perfect insects. They are found on plants, or at their roots. *Phytocoris lineolaris* is our most abundant and injurious insect. It appears early in spring. *Coreus tristis*, the squash-bug, (Fig. 27,) collects in numbers around the stems of squash vines next to the roots.



FIG. 27.

*Tingis hyalina* represents another family of broad, flattened semi-

transparent hemipters. The *hyalina* is very abundant on the willow early in summer.

*Capsus* is the type of another family, which consist of small species, with soft, rather narrow bodies, and long beaks and legs. They are very active, flying readily. They are found in flowers, and on fruit, such as raspberries.

*Cimicidae*. The bed-bug, (*Cimex lectularius*), has a small, somewhat triangular head, orbicular thorax, and large, round flattened abdomen. It is generally wingless, having only two small wing-pads instead. The eggs are oval, white; the young escape by pushing off a lid at one end of the shell. They are white, transparent, differing from the perfect insect, in having a broad, triangular head, and short and thick antennae. Indeed, this is the general form of lice, to which the larva of *Cimex* has the closest affinity. Some Cimices are parasites, infesting pigeons, swallows, &c., in this way also showing their near location to lice. The cockroach is the natural enemy of the bed-bug, and destroys large numbers. Houses have been cleared of them after being thoroughly fumigated with brimstone.

*Pediculi*, Lice. These degraded, wingless forms of Hemiptera, still preserve the mouth parts in the form of a sucker, but it is fleshy and retractile. The triangular head has two simple eyes. The body is rather long, the abdomen oval. They are generally white, and of minute size. The metamorphosis is very incomplete—that is, there are but slight differences between the larva and the imago. The species of *Pediculus* are blood-suckers, and parasitic upon Man and some of the Mammalia; different species being found upon different regions of the body. Different varieties are found living upon the bodies of different races of men.

*Mallophaga*, bird-lice, live on hair of mammalia and feathers of birds. In this group there are distinct jaws. Nearly every bird and mammal has its parasite, so that the number of species is actually very large.

#### NEUROPTERA.

As a suborder these insects are the most aquatic of any other similar group, and it is swampy low grounds, the banks of pools and rivers, the thick dense damp forests, that the collector must frequent to find them. The large Dragon-flies when taken by the net must be killed by brushing with alcohol or benzine carried in a

vial, and then the wings can be folded together and the insects be placed in bags, or pieces of paper, as directed for putting up Lepidoptera. The smaller, more slender and delicate species should be pinned directly in the collecting box, &c. Many species are caught by a light in the night time, such as *Polystoechotes nebulosus* and the *Phryganeidae*; and a bright light placed in damp situations by streams, &c., will attract large numbers. Like moths the smaller species are attracted a great distance by light. Other species of this family so numerous in New England, are found in great numbers floating in the lakes and ponds of the wild lands of Maine that are rare elsewhere. For the proper study of the genera of these insects, and often of the species, they should be collected in alcohol, so as to be studied in a flexible state.

The aquatic larvae and pupae can easily be reared in aquaria in jars and tumblers, taking care that the weaker species are separated from those more powerful and bloodthirsty. The little entomostraca or water-fleas serve as food for the smaller species. With very little care many species can be raised in this way, and so little is known of their transformation that figures and descriptions would be of great value. The interesting and varied habits of the different families can also easily be noted. They can be called summer insects, since few are found late in the fall or early in the spring. Hemerobius and several species of Phryganeids are found ere the snow has gone in the spring,—a few species of the latter family are found in November.

*Termitidae*. White ants, so called, from their resemblance to ants, and the snowy whiteness of their wings, and the pale colored female, like the true ants, are social, living in communities; while the majority are wingless males, often called neuters. In the winged individuals the wings are much larger than the body, being folded, when at rest, one upon the other. The wingless individuals have an enormous head with scissor-like mandibles. The American white ant, *Termes frontalis*, has been found in Massachusetts ruining the roots and stems of the grape vine. The insect is careful to conceal its work by leaving the outer crust intact. It feeds on dead wood, eating the inside of the sill of the house next to the grape vine.

*Psocidae*. These little insects when winged, as most usual, and flying about in August, have a remarkable resemblance to Aphides. The body is soft and short; the head is broader than the thorax;

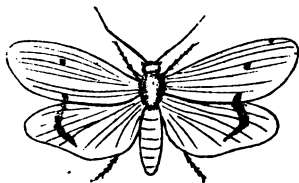
the wings are broad, the second pair much smaller than the first, both having raised nervures; the prothorax is very short.

*Atropos divinatorius* is the little wingless louse-like insect always running over the leaves of books, and about dusty places, and they feed on cabinet specimens, sometimes doing considerable injury. These little soft insects should be gummed on pieces of cards, or put into alcohol; while the winged species can be pinned with small pins.

*Phryganeidae*. (Caddice-flies, Case-worms.) The imago has a rounded body, with moderately broad, parallel veined wings, which are folded on the sides of the body, and the head is provided with long antennae and palpi. Both larvae and pupae are active. The smaller species are often hardly distinguishable from many small moths. The female lay their eggs in gelatinous masses on aquatic plants, above or beneath the surface of the water. The larvae are found abundantly in the bottom of ponds, in cylindrical cases of grass or stems of reeds, or bits of sticks, sand, minute shells, &c. They assume different forms, sometimes a long, conical shape, or imitating snail shells. The larva lines the interior with silk, and by bristles on the side of the body and a pair of anal hooks keeps its body adhering to the sides of the case while it drags it over the bottom. They eat large quantities of minute water fleas (entomostraca) and small insects, while many are herbivorous, the larger ones eating whole leaves that have been submerged, while the smaller ones leave the veins entire. When about to change to pupae, the larva closes up the mouth of its case with a net-work like a grate for the passage of the water for respiration. When about to leave the pupa state they crawl up stems of plants, or the smaller species use their light cases as rafts to rest upon as their wings are drying.

*Neuronia semifasciata*, (Fig. 28,) is our largest species, and is taken away from damp places; but the smaller species are only taken on leaves of bushes and herbage by streams and ponds. They run swiftly, but fly with some difficulty. The species are numerous. They should be pinned as moths, and their wings set carefully.

FIG. 28.



*Perlidae*. Long, flat neuroptera, whose hind wings are largest,

the abdomen with two terminal long filiform appendages. The females of *Perla* are shorter and have much smaller wings than the males. The pupæ are active, with prominent wing-pads, they are found in rivers under stones, while the imagines fly on the bank, or are found resting on leaves, always in damp low situations. *Pteronarcys* is distinguished from other genera by its large size, and possession of several pairs of outer tufts of filaments serving as organs for respiration.

*Myrmeleon*, the *Ant-lion* is the type of another family, very carnivorous in their habits. They resemble the Libellulidae very much except in having long antennae. The larvae, on the contrary, bear a close resemblance to that of *Chrysopa* figured below. It makes a pitfall in sand in which it hides, only showing its large jaws open to seize any insect that may fall into them. These insects have not been found in Maine.

*Hemerobiidae*. Aphis-lions, Lace-winged flies. *Chrysopa*, here figured, has a slender body, delicate, gauze-like wings, and is generally green, with golden eyes. When disturbed it throws out a fetid smell. They are very abundant in summer wherever plant lice are found, laying their eggs placed on long pedicels on leaves. The larvae (Fig. 30) feed ravenously on the lice, and when other food is wanting, on each other. They turn to pupæ late in summer and pass the winter in that state. Gardeners in Europe search for these Aphis-lions and put a pair or two on trees overrun with lice which they soon depopulate. *Hemerobius* proper, has broad pale rings, and is of smaller size than *Chrysopa*.

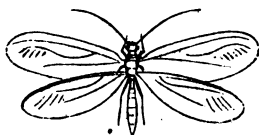
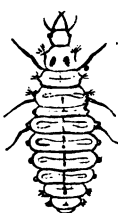


FIG. 29.

FIG. 30.



*Sialidae*. This group comprises aquatic, sluggish insects of moderate or of immense size. They have large heads with large jaws, square thoracic rings; and the abdomen in *Corydalis cornuta* has long anal filaments. This genus expands five or six inches, and the head is armed with immense horns, besides the long antennae, while the long wings are folded horizontally. In *Sialis americana*, an insect not an inch long and found resting on leaves of trees in their perfect state, the wings are deflexed on the sides, as in *Chrysopa*.

*Panorpa* represents another family, which have the head long and narrow, wings narrow and banded, and the tail armed with a tor-

ceps-like apparatus. It is common in woods and feeds upon other insects.

*Libellulidae*. Dragon-flies. Devil's-darning-needle. Mosquitoe-hawks. *Demoiselles* in France. The head is large and globular, eyes immense, encircling the head; thorax square, wings large net-veined, equal; abdomen long linear, cylindrical. They are continually flying over pools, hawking for smaller insects in hot summer days, flying often till dusk. Though dreaded by most persons, they are perfectly harmless, though giving a sharp bite with their powerful jaws when held in the hand. They are difficult to kill, and should be brushed with alcohol or benzine, or killed by ether. The *Agrionidae* are small slender species of graceful form, and blue, green or bronze or red colored, flying away and alighting upon rushes in the water, and are easy to catch; they must be pinned carefully, and are very brittle when dry. The large species are hard to catch; patience and swiftness in the use of the net will soon render the beginner dexterous. These insects have also their *subimago* state. They should be described in life, as the colors fade rapidly after death. The larvae (Fig. 31) are interesting. They have large jaws, marked by an immense labium, otherwise the mouth parts are much like grasshoppers, &c. The larva of *Agrion* is slender and long, with thin caudal lanceolate plates. They all walk over the bottom in search of other insects, and propel themselves more rapidly by ejecting behind them, with considerable force, a stream of the water that has been used for respiration.

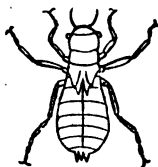


FIG. 31.

*Ephemeridae* or May flies, as their name implies, are very short lived insects. They have weak slender bodies, obsolete mouth-parts as they take no food in the perfect state, minute antennae, the wings are very unequal in size, and the abdomen has two or three long appendages. The May flies soon after leaving the pupa case with their wings of full size, cast off a thin pellicle. This moulting is attended by a change of color and of increase of length of the tail-like appendages, and this period is called the *subimago* state. They fly towards evening in large numbers. The larvae while resembling the imagines, have long antennae, mandibles for chewing, lateral ciliated filaments along the sides of the body for breathing organs, and three caudal filaments. They live, it is stated, two or three years. They either live in burrows, under

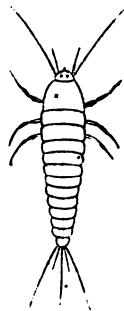
stones, or among grass and weeds, when they may be taken with the water net in great abundance, and are beautiful objects for aquaria. The perfect insects should be preserved in alcohol for study, as they shrivel up when pinned. They should be described when alive if possible.

*Thysanura*.—Spring-tails. These interesting, minute, wingless forms, which seem to afford a passage into the Myriapods by the uniform size of their rings, which form a continuous series, from their head to the extremity, without showing the usual divisions into three divisions of the body, seem to be but a degraded form of neuroptera by their resemblance to the larvae of *Perla* and *Ephemera*; for like them they have long antennae, distinct jaws and maxillae, and also caudal setae or bristles on the terminal ring of the body. Their limbs also strongly resemble those of *Perla*. Moreover they undergo no metamorphosis, the larva gradually assuming the adult form by successive changes of their skin. The species are found abundantly in moist, dark places, under sticks, stones, among fallen leaves, or under bark of trees, while some occur in great profusion about manure heaps and hot beds in early spring.

*Podura*. This genus is rather broad, the body is hairy with a few scales, antennae short and few jointed; the head is separate from the thorax, and the abdomen is provided with setae converted into a forked tail bent beneath the body, used for leaping to a great distance. They are found in gardens, hot beds, or leaping on the surface of the water in quiet pools.

*Lepisma*, (Fig. 32,) is long, and covered with minute silvery scales; the antennae are rather short, and the abdomen has three long bristles. The species run rapidly and are found in old books, in woolen cloths which they eat, in mould and under bark, &c.

FIG. 32.



#### ARACHNIDA.

Spiders have no antennae. Their legs present seven distinct joints, and the tarsi are two jointed. At the base of the mandibles is a vesicle filled with poison, which can be poured into the tips of the jaw, and thus poison the insects bitten by the spider. This bite, except in rare instances, is harmless to man. "Scorpions are viviparous. With the egg-laying spiders, the egg, under the



changes of development, slowly loses its previous form, and almost assumes that of a spider, indicating all the external parts of the enclosed animal. At length the shell bursts on the thorax, and the spider, first with the head, and afterwards with the thorax, comes to view ; then follows the abdomen, to which, however, the egg-membrane, like a scale, continues attached for a time ; then comes the feelers and feet. The young spider, through whose integument the granules of the yolk may be clearly distinguished, is not yet in a state to weave a web and catch its prey ; for the spinning organs are still concealed beneath the common integument. After the lapse of a week, or, in some species, a longer time, during which the spider takes no food, it casts its skin for the first time, and is, as it were, born for the second time. The young spiders now quit, on some mild day in May or June, the web in which the mother had hidden her eggs ; they allow themselves to fall on the ground by a thread, and begin at once to weave their nets, or in some other way, according to the instinct of their kind, to watch for small insects corresponding to their age and powers.

“ Most arachnids feed on other animals, which they either swallow alive, or whose blood and fluids they suck. Usually after their escape from the egg, they undergo no metamorphosis. They cast, however, their skin more than once, and are commonly after the fourth or fifth moult, in a state for pairing.” *Van der Hæven*.

In studying spiders, of which we have in New England over two hundred species, the number and relative situation of the eyes, and the relative length of the different pairs of legs should be noticed. Their web and the manner of constructing them ; their habitats, whether spreading their webs upon or in the ground, or in trees, or on herbage, or whether the species is aquatic, or whether the species is erratic, and pursue their prey without building webs to entrap them, should be observed. So, also, how they deposit their eggs, and the form and appearance of the silken nidus, and whether the female bears her eggs about her, and how this is done, whether holding on to the egg-sac by her fore or hind legs, should all be carefully noticed. Care must be taken not to mistake the young for full-grown, mature species, and describe them as such. Spiders can be reared in boxes as insects. The only way to preserve them is to throw them into alcohol ; when pinned, they shrivel up and lose their colors, which keep well in spirits.

The colors of spiders vary much at different seasons of the year,

especially during the frosts of autumn, when the changes produced are greatest. All spiders are directly beneficial to agriculture by their carnivorous habits, as they all prey upon insects, and do no harm to vegetation. Their instincts are wonderful, and their habits and organization worthy of more study than has yet been paid them. We have no species poisonous to man, except when the state of health renders the constitution open to receive injury from their bite, just as mosquitoes and black flies often cause serious harm to some persons.

The Arachnids are divided into two groups of families : First,

#### PULMONARIA,

which have pulmonary sacs for respiration, and six to twelve ocelli. This group includes two families, one consisting of the true *Spiders*, the other of the *Scorpions*.

*Araneidae*. Spiders. Palpi simple pediform ; mandibulae armed with a moveable and perforated claw, emitting a poisonous liquid. The genera have been divided by Walckenaer :

1. Into those that incessantly run or leap about the vicinity of their abode to chase and catch their prey. *Mygale* hides in holes in the ground or among stones. The largest spiders are found in this genus. *Filistata* forms white silk tubes in walls and crevices of rocks. *Dysdera* is found in silken tubes under ground. *Segestria* makes silken tubes under the bark of trees. *Lycosa* is found under stones, in holes, &c., bearing their cocoons attached to their anus, and carrying their young on their back. The Tarantula of Italy belongs to this genus. *L. fatifera* lives in holes nearly a foot deep. These holes seem to be dug by the spider, and to be increased gradually, as its size may require ; the opening has a ring of filaments woven by the spider to prevent the filling up of the cavity by rain. In *Dolomedes* the female of one species constructs a web not unlike that of *Tegenoria*. They wander near streams or ponds, often hiding under the surface of the water, or rambling on trees. *Spharus* makes no web, except when the female makes her cocoon. The species wander in quest of prey about the trunks of small trees, or upright trees, and when at rest, spread their feet like many species of *Thomisus*. I have reason to think that the young are carried on the back of the mother as in *Lycosa*. (*Hentz*, in whose words most of these remarks are given.) *Attus* leaps prodigiously after its prey. Some species closely resemble ants.

2. Into those species which wander abroad and are incessantly

spying out for prey. No fixed residence except at the period of oviposition. They also walk and run sideways or backwards; occasionally throwing out threads to entrap their prey. *Thomisus* wanders after its prey on flowers, rails, trees, &c.

3. Into those that prowl about the neighborhood of their nests, or near the threads which they throw out to catch their prey. *Clubiona* forms silken tubes in leaves which they twist, or under the bark of trees. Most species fly about in the air, by means of a long thread, at the end of which they suspend themselves, and which is borne by the wind, sometimes raising them to a great height. *Herpyllus* makes no web or tube for its dwelling, but wanders for its prey, and runs with great velocity. *H. atec* is a small black species found under stones in highways; *H. ecclesiasticus* is blackish with a white band on the head-thorax, a band on the abdomen, beginning at base and reaching the middle, and a spot near the apex white. This one attains to a great size, and is found in houses, under stones, planks, the bark of decaying trees, &c.

4. Into those which spin large webs to entrap their prey, lying in wait in the middle or at the side. *Agelena* makes in the fields a web which is spread horizontally, and at the upper part of which is a tube for the retreat of the spider. *Theridium* makes a web formed of threads crossed irregularly in every direction. Most species of this genus are the common prey of the several species of *Sphex*, called *sand-daubers*. *Pholcus* inhabits the ceiling of houses. *Tegenaria* makes in houses, cellars and other dark places the common webs, which are spread horizontally, and have a tube, usually concealed in a hole or crevice, for the reception of the spider. This is the common house spider, the web of which is narcotic and has been administered internally in some cases of fever with success. *Epeira* is the common large grey species with a full round abdomen which makes its large circular web in corners, &c.

5. Into those which swim in water, and then spread their filaments to entrap their prey. *Argyroneta* lives in fresh water. "One species spins a bell-shaped, water-proof web that is filled with air, and open below; this it attaches to water plants by threads." We have a species perhaps of this genus that collects on the leaves of water plants, and when disturbed plunges to the bottom, carrying with it a bubble of water. We have one species of spider which makes a noise somewhat resembling the purring of a cat; during the production of the sound the body makes a tremulous motion it is said.

The second group of families, which is called

#### TRACHEARIA,

embraces those arachnids which breathe by means of tracheae, or air tubes and do not have more than four ocelli.

*Pseudo-scorpionidae*. This family includes *Chelifer*, a small scorpion-like animal, which has a large, broad, flattened abdomen, distinctly ringed; and the palpi are much enlarged, bearing a claw at the extremity much like that of a lobster. A species is very common in books and dusty boxes, drawers, &c.

*Phalangidae*. Harvest-men, Daddy long-legs. The common long, slender legged, round, oval-bodied spiders, so abundant everywhere out of doors in corners and damp places, and often called by the names above given, are known to every one. The legs come off easily, and when separated from the body for some time show considerable irritability.

*Acarina*. Mites have the head-thorax joined in a mass with the abdomen, and not divided apparently into rings. They are all of small size, some very minute. *Trombidium* has two horny mandibles, which are clawed at the end, included in the labium, which in the mites surrounds the mouth parts, thus forming a tube-like organ. This genus includes the little square velvet red mite, seen generally in the spring in flower beds, or in moss, &c. Another similar kind of red mite is common about decaying matter under stones and sea weed between tide marks on the sea shore. They are mostly parasitic, such as the itch mite. *Ixodes*, the tick, lives in woods and attaches itself to animals. Many species (*Gamasus*) are found on insects, especially beetles. The species of *Hydrachna* live on water-bugs, &c. In coming to maturity it passes through forms which have been described as distinct genera by authors. They should be preserved in small vials of alcohol, or mounted for the microscope.

#### MYRIAPODA.

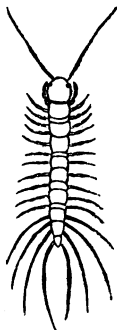
All the species, of which we have but a few in New England, live hidden under stones and sticks, leaves, &c., The larvae when hatched have generally nine rings which afterwards increase in some cases to eight times that number.

The families are divided into two suborders, of which the first, the *Chilopoda*, comprises those myriapods which have the body flattened, with a limited number of rings, each of which has a

single pair of legs articulated to the sides, of which the last pair is largest and extended backwards. The antennae are long and with numerous joints.

*Lithobiidae.* *Lithobius*, (Fig. 33,) called in this country Ear-wig, is our most common genus, and is found every where, under sticks and about manure heaps, where they feed upon insects and earth worms, and are in turn devoured by the red back salamander. The head is large orbicular, antennae forty-jointed, long and filiform, and there are sixteen rings in all. They are fast runners.

FIG. 33.



*Scolopendridae.* *Scolopendra*, the Centipede, has twenty rings besides the two that form the head; antennae 17-20 jointed. A rather slender species about three inches in length, is found in Maine, under dead leaves.

*Geophilidae.* *Geophilus* is greatly elongated and slender, with many rings, from thirty to two hundred. A small, slender species, is common under leaves, and debris of freshets, where so many varieties can be found.

Those Myriapods included in the second suborder, *Chilognatha*, have a greater number of rings, each of which bears two pairs of legs, and few jointed short antennae. In *Polydesmus* the body is still flattened and the legs articulated upon the sides of the body. A species occurring in considerable abundance with the myriapods is about an inch long and of a pale brown color.

*Julidae.* (Thousand-legs.) *Julus* is found commonly under sticks, &c. It is long, cylindrical, hard, with numerous feet, short and weak, attached to the under surface of the body nearly in the middle of the abdomen. The antennae are short and filiform. They crawl rather slowly, and at rest curve the body into a ring. They live on vegetable substances, or eat dead earth worms or snails. "In the spring the female deposits her eggs in masses of sixty or seventy, in a hole excavated for the purpose under the ground; after three weeks or more the young make their appearance, but still continue to adhere for some days by a string to the shell, which has burst longitudinally without motion, and surrounded with a proper membrane; at that period they have no legs at all; as soon as they have got three pairs of feet, they separate themselves from the shell; they have now a great resemblance to the larvae of some Coleoptera; soon the number of rings

and feet begins to be [periodically] increased in that part of the body which is seated in front of the penultimate ring." *Van der Hoeven*.

ENTOMOLOGICAL JOURNAL. Every collector should keep a daily diary of his captures and observations, noting down every fact and hint that falls under his notice. In this book, commenced as soon as the season opens in early spring, can be placed on record the earliest appearance, the time of greatest abundance, and the disappearance, of every insect in any of its stages. Also the descriptions of larvae and observations upon their habits, with sketches of them; though drawings had better be kept upon separate pieces of paper for easier reference. The insects when captured and unnamed, should be numbered and refer to corresponding numbers in the note book. At the close of the season one will be surprised to see how much material of the kind has accumulated. He can then make a *calendar of appearances* of perfect insects and larvae, so as to have the work of the next season portioned out to him; he will thus know when and where to look for any particular insect or caterpillar.

*Cabinet.* After the insects have been thoroughly dried they may be transferred to a chest of drawers of a convenient size, say eighteen by twenty inches and two and one-half inches deep, corked upon the bottom and glazed above, and thus rendered as nearly air tight as possible to keep out *Dermestes*, mites and moths. The insects should be arranged neatly in rows, labelled or numbered with small pieces of paper attached to the pin. Enough individuals should be selected to illustrate the sexes and variations of the species. Boxes three inches or more deep and twelve by eighteen inches square, rabbetted around the edges rather broadly, are very convenient. Cork in sheets can be had of R. Beeching & Co., Commercial St., Boston. It can be cut in strips or the whole surface covered and fastened down with glue, or better still with tacks. The pith of elder, corn stalk, or felt or palm wood, are substitutes for cork. For transporting specimens for exchanges, they should be pinned securely in boxes, lined with compact cork, and the boxes wrapped in cotton, covered thickly with paper, and then placed in a larger box.

For guarding with some success against the attacks of insects, the drawers should be provided with camphor or little bottles containing spirits of turpentine or benzine, to be kept always full.

Specimens can be relaxed by exposing them to steam or hot water. Lepidoptera can be softened and their wings expanded, after having been laid on moist sand for a few days, or confined in a vessel of warm water on the surface of which they can be floated on bits of cork.

The *strongest alcohol* is necessary for preserving insects; and when a bottle has been filled, the old alcohol should be poured out and kept for other collections, and its place filled by fresh alcohol.

When the collector has no box with him his captures can be wrapped in papers or stuck on his hat, or in the lining within. Lepidoptera can be very easily laid in papers a little longer than broad, which should be so folded that the opposite corners can be laid one upon the other, leaving a margin on the under side which can be folded upon the upper side, thus making a triangular paper case, in which the insect soon dries. In this way many specimens can be easily transported.

#### ENTOMOLOGICAL WORKS.

The best introduction to American Entomology is the new edition of Dr. Harris's Treatise on Insects. It not only classifies and describes many of our New England insects, illustrating them with colored engravings and wood cuts in great profusion, but is of special value to farmers, from the great amount of information about the habits of noxious insects. Dr. Fitch's Reports on the Noxious and Beneficial Insects of New York, with some illustrations, and accounts of the habits of many insects not especially noticed in the former work, is a very necessary book to have. Kirby and Spence's Introduction to Entomology, and Westwood's Introduction to the Modern Classification of Insects, are still more general works, almost indispensable to the beginner.

Very many of our American insects have been collected by Europeans, and described by their entomologists in the transactions and proceedings of learned societies, which are to be found only in our large libraries. There are also many large and expensive general works, including those of Linnæus, Fabricius, Count De Geër, Palisot de Beauvois, Drury, Bosc and Coquebert, which include many North American species.

St. Fargeau, Newman and Haliday, in the Entomological Magazine; Smith in the British Museum Catalogues of Hymenoptera, and M. De Saussure in his Monographs of the Vespidae, have

described many of our hymenoptera. Hübner, Cramer, Madam Merian, and more lately Herrich-Schäffer, Doubleday and Westwood, have published large illustrated works, containing many of our Lepidoptera. Guéneé has published five illustrated volumes where hundreds of our moths are first described. Likewise, for the Diptera, the special works of Desvoidy, Macquart, Meigen, Wiedemann, Zetterstett and Loew, are necessary to identify North American flies.

For Coleoptera, which have been largely described abroad, the standard authors are still more numerous. The names of Aubé, Bonelli, Erichson, Dalman, Dejean, Illiger, Klug, Knoch, Eschscholtz, Forster, Germar, Gravenhorst, Guérin, Hope, Lacordaire, Newman, Paykull and Schönherr, can only be mentioned. Burmeister in his Hand-book of Entomology has described many of our beetles, Orthoptera, Neuroptera and some Hemiptera. Stoll, Herrich-Schäffer, Hahn and Haliday have also described more Hemiptera. Serville, in his Natural History of Orthoptera, mentions many American grasshoppers. There is also the general work of Rambur published like those of St. Fargeau, Macquart, Guéneé and Serville, in the Suite à Buffon in Paris, with those of De Selys Longcamp on Libellulidae. Pictet has written on the Perlidae and Ephemeridae, while several papers of Hagen treat of the Neuroptera. The British Museum is publishing catalogues of the various suborders containing great numbers of American insects.

Of those works treating of American insects exclusively, the rare and costly work of Smith and Abbot on the Rarer Lepidopterous Insects of Georgia, delineates the metamorphosis of many southern butterflies and moths. More lately Boisduval and Le Conte issued an Iconography of North American butterflies, giving drawings of the metamorphosis of many species. This important work leaves the Hesperidae unfinished. In 1817-18, Thomas Say published his American Entomology, which includes insects of all the suborders, in three finely illustrated 8vo. volumes, accompanied with a glossary. This, with Say's miscellaneous papers, which chiefly appeared in the Journal of the Philadelphia Academy of Natural Sciences, have been re-printed under the care of Dr. Le Conte. Through the Transactions of the American Philosophical Society, the Journal and Proceedings of the Philadelphia Academy of Natural Sciences, the Annals of the New York



Lyceum of Natural History, the Proceedings and Journal of the Boston Society of Natural History, and the Proceedings of the Philadelphia Entomological Society which has lately been established, are scattered memoirs and tracts by Melsheimer, Ziegler, Hentz, Harris, Haldeman, and the two Le Contes, which are mostly upon Coleoptera. Dr. Randall published a paper describing many new beetles from Maine in the Boston Journal. Dr. Clemens has published in the Philadelphia Journal a synopsis of North American Sphingidae; and in the Proceedings of the same Society descriptions and notes of the habits of the small moths. Mr. Scudder has printed in the Boston Journal "Materials for a monograph of North American Orthoptera;" and Messrs. Uhler and Walsh have written upon the Neuroptera of the United States. Mr. Norton has described in the Proceedings of the Boston Society descriptions of new Hymenoptera. Baron Osten-Sacken has printed in the Phil. Proceedings an elaborate paper on the *Limnobiae*, a group of Tipulidae, and also his researches on Gall-flies and their products.

The insects of British America have been treated of in Kirby's Fauna Boreali-Americana. This well illustrated quarto volume is of special value, since it describes so many insects which are found in Maine. In the New York State Natural History Reports, is a quarto volume, with many plates illustrating the injurious and beneficial insects of that State, by Dr. Emmons. Mention should also be made of the writings of Mr. Townsend Glover on the Cotton and Orange insects of the Southern States, which appeared in several volumes of the Patent Office Reports, and of several papers by Le Conte, in the Reports of the Pacific R. R. Exploration, and Stansbury's Report on the Salt Lake.

There is still needed a general work to combine these scattered materials, and the results of further investigations. The Smithsonian Institution is in a great measure supplying this deficiency, and promoting a zeal for these studies that is being manifested throughout the country. Catalogues of the Lepidoptera, and also a compilation of all the descriptions of the Lepidoptera of North America as far as the Bombyces; by Dr. Morris; of the Diptera by Baron Osten-Sacken, with a treatise on the *Cecidomyxæ* and their galls; together with Monographs of several Dipterous families by an eminent European Dipterist, M. Loew; and of the Coleoptera by Dr. Melsheimer, revised by Le Conte and

Haldeman, and also a work entitled the Classification of the Coleoptera of North America, (Part I,) by Dr. Le Conte, together with a synopsis of the Neuroptera of North America, by H. Hagen, an accomplished Neuropterist of Belgium, have been issued under the auspices of that Institution. Similar works on Hymenoptera by M. De Saussure of Geneva; and on the Hemiptera by Mr. Uhler of Baltimore, are in course of preparation for the Smithsonian Collections. A list of described North American Hymenoptera by Mr. Cresson, is now appearing in the Proceedings of the Entomological Society of Philadelphia. H. C. Wood, Jr., has written in the Philadelphia Journal, an account of the Chilopodous Myriapods of the United States. The Spiders of the Southern States more especially, have been described and beautifully illustrated by Prof. Hentz, in the Boston Journal of Natural History.



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